

FROM THE PAEDIATRIC CLINIC OF KAROLINSKA SJUKHUSET, STOCKHOLM, SWEDEN

(*Head*: PROFESSOR ARVID WALLGREN, M.D.)

and

THE STATE INSTITUTE OF HUMAN GENETICS AND RACE BIOLOGY, UPPSALA, SWEDEN

(*Head*: PROFESSOR GUNNAR DAHLBERG, M.D., LL.D.)

THE LONG-TERM PROGNOSIS FOR PREMATURELY BORN CHILDREN

A Follow-Up Study of 999 Premature Boys Born in Wedlock
and of 1002 Controls

By

INGVAR ALM

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Av

INGVAR ALM

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by

Erica Odelberg

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ALMQVIST & WIKSELLS BOKTRYCKERI AB

To the Memory of

J. HENNING MAGNUSSON, M.D.

Late Physician-in-Chief, The Sachs' Hospital

for Children, Stockholm, Sweden

PREFACE

I wish to express my sincere gratitude to the following persons for their valuable assistance during the planning and performance of the present investigation.

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Stockholm, March 1953.

INGVAR ALM

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CHAPTER I

Definition

In the present paper, a premature infant denotes an infant who weighs 2500 grams or less at birth. This definition in terms of weight has been used intermittently since the eighteen-sixties. It was motivated at an early stage on the grounds that newborn infants with a lower birth weight presented special problems, particularly of a paediatric nature, which distinguished them from infants with a higher birth weight. It was, however, only after Ylppö's three publications in 1919 that this weight became more generally accepted as a clinical standard of prematurity, at any rate by paediatricians. For practical reasons, the 5 gram groups above and below 2500 grams, respectively, were soon included. In order to establish a uniform classification, the American Academy of Paediatrics passed the following resolution in 1935:

"A premature infant is one who weighs 2500 grams or less at birth (not at admission) regardless of the period of gestation."

This borderline figure was also recommended by the Committee on Hygiene of the League of Nations in 1937 and by the World Health Organization in 1950. The latter organization proposed the term *immaturity*, stating that: "An immature infant is a liveborn infant with a birth weight of 5 1/2 lb. (2500 Gm.) or less or specified as immature (a period of gestation of less than 37 weeks)." The term immaturity had, however, already been suggested by Ylppö¹ for scarcely viable infants with a birth weight of 1250—600 grams or less, and this conception has been accepted to a certain extent. For this reason and because in assembling the present material I only took the birth weight into consideration, I have retained the term premature, using it to denote infants with a birth weight of 2500 grams or less.

Obstetricians, on the contrary, have often used the length of pregnancy from the beginning of the 28th week up to and including the end of the 37th week as the only criterion of prematurity. The disadvantage is that the date of conception cannot be stated with certainty. Moreover, the statements regarding the date of the last menstrual period are often approximative and, in some cases, deliberately inaccurate.

As far as the length at birth is concerned, different examiners may give fairly divergent figures for the same children, on the grounds of such factors

¹ At Nordisk Pediatrisk Kongress, Helsinki 1946.

as the flaccidity of the tissues. It is therefore considered to lack reliability as a criterion of prematurity in scientific work.

The obvious advantage of using the birth weight is that, even with the type of scales that have been in use for many years, it can be given to within 10 grams. The disadvantage — which is seldom pointed out in the literature — is that weighing does not always take place immediately after birth but up to 30 minutes later. This applies in particular to multiple births and to complicated labour; the mother then requires immediate attention and weighing is postponed. During this time the infant may have urinated or evacuated the contents of the ampulla of the rectum. Asphyctic infants with meconium in the liquor amnii also have a somewhat too low official birth weight. For these reasons, the minimum weight might be a better criterion for comparative purposes, but this would necessitate standardized conditions in other respects during the first three days of life, which is scarcely the case.

The figure noted on the obstetric case-sheet as the birth weight is that used as the criterion of prematurity in all modern paediatric literature; this applies in the present paper as well.

CHAPTER II

Review of the Literature

1. Course of the Discussion

The prognosis for premature infants and the importance of prematurity for the occurrence of subsequent mental subnormality has been discussed by orthopaedists, psychiatrists, neurologists, obstetricians, paediatricians and psychologists. According to Wall, RITTER (1849) was the first in the medical literature to associate mental deficiency with high-grade prematurity. In 1862, LITTLE's work "On the Influence of Abnormal Parturition, Difficult Labours, Premature Birth and Asphyxia Neonatorum on the Mental and Physical Condition of the Child, Especially in Relation to Deformities" was published. Of the 63 cases in his series, 29 appear to have been premature (Brander). During recent decades, YLPPÖ 1919, CAPPER 1928, SARWAN 1930, BRANDER 1936, BENTON 1940 and DUNHAM 1948 in particular have made extensive surveys and criticisms of the relevant literature.

On broad lines, the course of the discussion has been the following. During the later years of the 19th century, intermittent reports were published of a relatively high incidence of low birth weight and birth before calculated term in cases of Little's disease, epilepsy and mental deficiency. In the beginning of the present century, up to about 1919, the prognosis for premature infants was discussed mainly by obstetricians. They based their statements on follow-up examinations of cases of complicated delivery. Induced labour before term was then a method frequently used. The results of the investigations showed that this method was associated with a considerable risk of immediate death of the child. The risk of later developmental disturbances was not considered to be so great. WALL's publication of 1913 is generally regarded as typical of this period.

YLPPÖ's now classical studies were published in 1919. They dealt mainly with the pathological anatomy, physiology, clinical aspects and physical development of the premature infant, but also touched briefly on the mental development up to school age. Ylppö's final prognosis on the last-mentioned point was somewhat pessimistic, particularly with regard to the smallest prematures. His opinion was strongly opposed to that of Wall and Pfaundler in particular, who had found no increased incidence of mental deficiency in their series. Ylppö stated that the high incidence of mental deficiency and of

spastic paralysis in his own series of prematures was to be ascribed to birth injuries and not to "degenerative" traits.

Between 1919 and 1927, only few articles were published on the prognosis for prematurely born children. They did not cover large series and contributed nothing essentially new to the discussion.

In 1927, COMBERG published, from the same maternity hospital as Ylppö, a follow-up examination of premature infants born in the years following World War I. She included only children born in wedlock and belonging to a relatively high social stratum and found the prognosis to be good. Only 1 out of the 50 children was denoted as mentally deficient.

In the following year (1928), two reports were published which were of considerable importance for the further development of the discussion. LOOFT in Norway was the first to make objective measurements of the mental development of prematurely born children with the Binet-Simon-Terman test. He used his own developmental test for children aged 1—3 years. He concluded that prematurity is, directly or indirectly, an important causative factor of mental deficiency and developmental disturbances in children. CAPPER also reported on a series of prematurely born children in 1928. They were born in Vienna during World War I and the years immediately following it. His final evaluation of the prognosis for these children was extremely pessimistic.

These investigations with their conflicting results and attempts to approach the problem from new angles gave fresh impetus to the discussion. A considerable number of articles were published up to 1930, including MOHR and BARTELME's first work (1930) and that of OSSELMAN (1930), in which the I.Q. was used as a gauge of the degree of development. The period may be considered to be ended with the publication of the extensive study made by the Norwegian obstetrician SUNDE in collaboration with the school psychiatrist LOFTHUS. They used the I.Q. to evaluate the development of the prematurely born children and presented a comparative series satisfactory from the environmental point of view.

During the subsequent few years, no studies were published on the relevant problems. In 1934, two publications in the U.S.A. re-opened the discussion. The main conclusion drawn by ROSANOFF and INMAN-KANE from their investigation was that prematurity is an aetiological factor in the occurrence of mental deficiency. They stated, however, that it is usually caused by birth injuries, such injuries being more common in premature than in full-term infants. The publication of MOHR and BARTELME is still the most important in this field. The study included both developmental and intelligence tests of children followed up for a considerable period. Moreover, the comparative material is satisfactory from most points of view, since it consisted of the full-

term siblings of a number of prematures in the series. The authors found no reliable difference between the respective categories of children, if the number of months of prematurity was subtracted from the chronological age. Children who had suffered birth injuries showed a tendency to retarded development. The authors found no direct relationship between the I.Q. and the birth weight.

Two extensive studies were also published in Europe, namely by the Dutch obstetrician DUYZING (1935) and BRANDER (1936), from Ylppö's clinic in Finland. The results were conflicting. The former author concluded that prematurity in itself does not lead to mental deficiency, which is caused by genetic factors. Brander showed a linear relationship between the birth weight and the I. Q., after children with hereditary mental traits and severe birth injuries had been excluded. He expressed a pessimistic view with regard to the possibility of normal development in the smallest prematures.

The four last-mentioned publications dominated the discussion during the later part of the nineteen-thirties and the studies published up to the outbreak of World War II contributed no essentially new features. The results ranged between the extremes represented by the opinions of Mohr and Bartelme and of Brander, respectively.

Extremely few studies on the late prognosis for premature infants were published during World War II. After 1945, the discussion was re-opened; since then the conclusions have continued to range between the two extreme views already mentioned. A survey of the literature is given in tabular form.

2. Tabular Survey

Comment

Whenever possible, I calculated the number of those traced as a percentage of the number of prematurely born infants discharged alive from the hospitals in question. In some investigations, the number traced was not the same as the number who underwent a follow-up examination.

The methods used for the evaluation of the prognosis are abbreviated as follows:

Questionnaire to the mother	QM
Progress at school	PS
Clinical impression	CI
Intelligence quotient	IQ
Developmental quotient	DQ
Control group	CG

The pathological conditions frequently stated in the literature to be associated with premature birth are abbreviated as follows:

Yr. of publ.	Author	Country	No. of cases	Criterion of prematurity	Per cent traced	Age at exam. yrs.	Method used	Severe abnormalities reported
1913	WALL, M.	Germany	56	<9 mths.	37	2—20	QM PS CI	2 Ep
1919	YLPPÖ, A.	Germany	323	<2 500 Gm.	89 $\frac{1}{2}$	$\frac{1}{2}$ —8	QM CI	{7.4 % Imb 3.1 % Sp
1921	SCHWARTZ <i>et al.</i> ...	U. S. A.	26	$\geq$ 2 500 Gm.	—	1—6	QM	2 Dp
1923	LOOFT, C.	Norway	38	<9 mths.	—	$\frac{1}{4}$ —3 $\frac{1}{4}$	DQ	—
1924	BRANDT, P.	Germany	72	<2 500 Gm.	84	7—?	CI	3 Sp 6 Dp
1924	FORSCHNER-BÖKE...	Germany	14	<2 500 Gm.	67	1 $\frac{1}{2}$ —7 $\frac{1}{2}$	CI	1 Dp 1 Imb
1926	SALOMONSEN, L....	Norway	39	<2 500 Gm.	61	2—10 $\frac{1}{2}$	CI	21 % Dp
1927	COMBERG, M.	Germany	73	<2 500 Gm.	89 $\frac{1}{2}$	3—7	QM CI	1 Dp 2 Sp
1928	CAPPER, A.	Austria	103	<2 500 Gm.	58	1—19	CI	{5 % Ep 7 % Imb 67 % Dp
1928	FRANKE, <i>et al.</i>	Austria	74	$\geq$ 2 500 Gm.	43	4—10	CI QM PS	1 Sp 5 Dp
1928	KELLER, C.	Germany	36	<9 mths.	87 $\frac{1}{2}$	3—11	CI QM	{7.5 % Sp 33 % Dp
1928	KORTHAUER, O. ...	Germany	81	$\geq$ 2 500 Gm.	86	1 $\frac{1}{4}$ —20	QM CI	28.5 % Dp
1928	LEVY, S.	Germany	77	<2 500 Gm.	46	1—10	CI PS	3 Imb 13 Sp
1928	LOOFT, C.	Norway	91	<2 500 Gm.	—	7—?	IQ	7.7 % Dp
1929	HERZ, O.	Germany	62	$\geq$ 2 500 Gm.	74	1—5	CI QM	4.8 % Imb
1929	STEINFORTH, T. ...	Germany	73	$\geq$ 2 500 Gm.	62 $\frac{1}{2}$	7	CI	1 Sp
1929	ZIMMERMANN, I. ...	Austria	86	<2 500 Gm.	—	3—5	CI	5.6 % Dp
1930	RANKE, S.	Sweden	73	$\geq$ 2 500 Gm.	67 $\frac{1}{2}$	3—12	CI	5.5 % Dp
1930	SUNDE <i>et al.</i>	Norway	559	<2 500 Gm.	64	6—21	{QM CI PS IQ CG	5.7 % Dp
1934	MOHR <i>et al.</i>	U. S. A.	250	$\geq$ 2 500 Gm.	—	1—9 $\frac{1}{2}$	CI IQ CG	—
1934	ROSANOFF <i>et al.</i> ...	U. S. A.	146	$\geq$ 2 500 Gm.	42	6—16	IQ	10.3 % Dp
1935	DUYZING, A.	Holland	712	<38 wks.	95 $\frac{1}{2}$	7—26	PS	6.6 % Dp
1935	FRIEDLÄNDER, A...	Denmark	64	<2 500 Gm.	67 $\frac{1}{2}$	5—15	QM CI	30 % Dp
1936	BRANDER, T.	Finland	376	$\geq$ 2 500 Gm.	77	7—15	IQ	{24.5 % Dp 8 Ep
1936	VON SYDOW, G....	Sweden	37	$\geq$ 2 500 Gm.	92	7—9 $\frac{1}{2}$	IQ CG	7.1 % Dp
1937	BAEDORF, K.	Germany	27	$\geq$ 1 700 Gm.	—	5 $\frac{1}{4}$ —17	QM PS IQ	5 Dp
1937	SIEDENTOPF, H. ...	Germany	188	<2 500 Gm.	—	10—14	QM PS IQ	14.7 % Dp
1938	VON CANSTEIN, H...	Germany	25	1 700—2 500 Gm.	67	9—16	QM CI IQ	{1 Dp 1 Sp 1 Im
1938	SCHÖBERLEIN, W...	Germany	96	$\geq$ 2 500 Gm.	35	6—18	QM PS IQ	3 Dp 3 Imb.
1938	SHIRLEY, M.	U. S. A.	63	<5 lbs.	—	$\frac{1}{2}$ —2 $\frac{1}{2}$	DQ CG	—
1939	BEITEL, L.	Austria	119	$\geq$ 2 500 Gm.	—	$\frac{3}{4}$ —6 $\frac{1}{2}$	DQ IQ	—
1939	KERNAU, T.	Austria	72	$\geq$ 2 500 Gm.	45	2 $\frac{1}{2}$ —20	CI	6 Dp 2 Sp
1939	MUHL, G.	Sweden	79	<2 500 Gm.	79	1—4	CI	3 Dp 3 Sp
1939	SCHULTZE, K.	Germany	160	$\geq$ 2 500 Gm.	42	8—13	QM CI	{2 Imb 2 Dp 3 Sp
1941	EFFKEMAN <i>et al.</i> ..	Germany	29	35—47 cm.	64	6—10	CI PS	7 % Dp
1945	BARLOW, A.	England	514	<5 $\frac{1}{2}$ lbs.	—	$\frac{1}{2}$ —8	IQ CG	33.6 % Dp
1946	ASHER, C.	England	217	$\geq$ 2 500 Gm.	32	1—6	DQ IQ	—
1948	DRILLIEN, C.	England	103	$\geq$ 2 500 Gm.	40	1 $\frac{1}{2}$ —4 $\frac{1}{2}$	CI	—
1949	BESKOW, B.	Sweden	273	$\geq$ 2 500 Gm.	92	9—17	PS IQ CG	{12 Dp 1 Imb 2 Ep 9 Sp
1949	CHMELO <i>et al.</i>	Czechoslovakia	35	$\geq$ 2 500 Gm.	12	2—14	QM	—
1949	HESS <i>et al.</i>	U. S. A.	216	$\geq$ 1 260 Gm.	96	$\frac{1}{2}$ —25 $\frac{1}{2}$	CI	5.3 % Dp
1950	KAHL, M.	Germany	49	<1 700 Gm.	37	9—19	IQ	7 Dp 1 Sp
1950	KOENIG, H.	U. S. A.	650	$\geq$ 2 500 Gm.	—	2—10	CI IQ	{4 Mo 10 Imb 2 Sp
1950	SCHACHTER, M.	France	183	$\geq$ 2 500 Gm.	—	—	IQ	31 % Dp
1951	BRUSA <i>et al.</i>	Italy	543	$\geq$ 2 500 Gm.	—	4—14	CI	31 Dp 3 Imb
1951	LEVESQUE <i>et al.</i> ...	France	60	—	50	3—?	IQ	8 Dp 3 Imb
1952	HOWARD <i>et al.</i>	U. S. A.	22	$\geq$ 1 820 Gm.	—	8—19	IQ	—
1952	BLEGEN, S.	Norway	541	$\geq$ 2 500 Gm.	79	8—17	IQ	7.5 % Dp
1952	AHNSJÖ, S.	Sweden	374	$\geq$ 2 500 Gm.	—	1—15	DQ IQ CG	—

Epilepsy	Ep
Spastic paralysis (Little's disease)	Sp
Severe mental deficiency	Imb
Slight mental deficiency ("Debilis psychica")	Dp
Mongolism	Mo

It may be mentioned that the opinions regarding the borderline between severe and slight mental deficiency have varied appreciably during the period in question and in different countries. The present survey cannot, therefore, be considered as exact in every detail. Its object is merely to give a brief review of the way in which attempts have been made by various authors to evaluate the late prognosis for prematurely born children.

3. Critical Survey of Certain Investigations

A more detailed account is given in the following of some investigations which are of general interest and which are based on relatively large series. In the majority of instances, the follow-up series consisted of more than 100 cases. It is obviously extremely difficult to judge these investigations fairly in the light of the knowledge of the relevant questions prevailing at the time of publication. I have therefore judged them according to the present views on how a series of prematurely born children should be compiled.

My object in making this more detailed, critical survey of the literature was to attempt to ascertain the reasons for which the results have not withstood the proof of time. The views on the long-term prognosis for prematurely born children are still extremely divergent. I have focused particular attention on those factors which make it inadvisable to draw generally applicable conclusions from the series in question. In certain cases I have also, on the basis of the primary figures given, made re-calculations of certain factors in order to make it easier to survey these studies against the background of my own problems.

With regard to the intelligence and developmental tests used in the various investigations, I have retained the denotations used by the authors and have not attempted to introduce any uniform nomenclature.

WALL's (1913) basic material consisted of 691 prematurely born children of mothers who had been in-patients or out-patients at the Breslau Obstetric Clinic in 1892—1910. Of these children, 492 survived the first weeks of life. Wall was able to trace 200 of them and to obtain information about 183 (37.2 per cent); 126 were dead, and 57 alive and between the age of 2 and 20 years. The criterion of prematurity appears to have been a pregnancy of less than 9 months. The initial social and economic status was poor. The follow-up

investigation was based on a questionnaire addressed to the mother; in those cases in which a personal examination was made, the clinical evaluation of the author was given. A report of the achievements at school was given for the children of school age.

According to Wall, these children walked and talked at a later age than that considered to be normal, the retardation being directly proportional to the degree of prematurity. The schoolchildren all attended ordinary schools and appeared to have compensated for the slight retardation shown in pre-school age. Two children were epileptic, but none of those in the series suffered from spastic paralysis or were mentally deficient. A number exhibited nervous symptoms such as nocturnal enuresis, speech disorders or night terrors. The objections that may be raised to this investigation are that the incidence of those traced was low, that many of the data were based on the mother's statements alone and that no normal material, comparable from an environmental point of view, was presented. The actual number of cases followed up was exceedingly small and the author's subjective evaluation seems to have been based on a single examination.

Wall's work appears to have had considerable influence on the opinions regarding the prognosis for premature infants during the years following its publication. It was frequently quoted and contrasted to Ylppö's results with respect to the late prognosis.

YLPPÖ's (1919) series consisted of 668 premature infants born at Kaiserin Augusta Viktoria Haus between 1910 and 1918. He followed them until the age of 8 years and obtained information about all except 70. These 70 consisted mainly of older children, so that 28 per cent of the 7-year-olds and 21 per cent of the 8-year-olds could not be traced. Of the remaining 598, 320 were dead. Ylppö gave the incidence of idiocy or of definite imbecility as 24 (7.4 per cent) and of Little's disease as 10 (3.1 per cent). With regard to length and weight, he stated that the premature infants with a birth weight of over 1000 grams reached the same level as the full-term infants between 5 and 6 years of age — "the age of conception" as he termed it.

In my opinion, the objections that can be raised to this study as a basis for generally applicable conclusions regarding the prognosis for premature infants are — on broad lines — the following. The expectant mothers, and subsequently their children, lived in Berlin under the conditions of starvation and hardship that prevailed during World War I and the years immediately following it. There was a high incidence of rickets among the children and epidemic influenza raged during several years. The incidence of premature births was particularly low, *i.e.*, 5.3 per cent as compared to 10—11 per cent at other maternity hospitals in Germany during the same period. Ylppö himself stated on page 8: "Diese Zahl kann aber keineswegs für die deutschen

Verhältnisse als Norm betrachtet werden, denn in unserer Entbindungsabteilung werden nur Frauen aufgenommen, die bei der vorausgehenden Untersuchung als gesund befunden werden und in Bezug auf den Geburtsverlauf keine Komplikationen erwarten lassen.”¹ The premature infants who were born at this clinic had, according to Ylppö himself, a good initial situation from a medical and obstetric point of view in comparison to the current norms for Germany as a whole.

COMBERG's study (1927) was from the same clinic as Ylppö's. It covered the premature infants born between 1919 and 1922, but only included the children born in wedlock and belonging to educated and financially secure social groups. The author stated that children born out of wedlock comprised only a small part of the material at this clinic. The infants in her series were either born at the clinic or had been transferred there. The latter category may be considered to be selected in that no dead children were represented, whereas the living children with complications were presumably over-represented. This can, however, only be surmised since no such data are given. The series originally consisted of 233 children; 136 of them died during the first year of life. Of the remaining 97, 81 could be traced; 50 of them underwent a follow-up examination between the age of 3 and 7 years. Written information was obtained about a further 23. Only one out of the 50 children examined could be denoted as mentally deficient. A further two suffered from Little's disease. Comberg considered the prognosis for prematurely born children to be definitely good, although there was a high incidence of nervous symptoms such as irritability, hyperactivity, negativism, anxiety and disturbances of sleep.

CAPPER (1928) published in the U.S.A. a report of a series from the Paediatric Clinic of the University of Vienna. He denoted the children with a birth weight below 2500 grams as immature and those born before calculated term, irrespective of the weight, as premature. Between 1911 and 1926, 247 children with a birth weight definitely below 2500 grams were discharged from the clinic. Reliable statements regarding 140 of them could be obtained; 23 had died and 103 returned for a follow-up examination. Capper examined them himself and included information concerning their achievements at school. The age at the follow-up examination ranged between 1 and 19 $\frac{1}{2}$ years. The oldest of them could not have been among those born in 1911—1917, since the examination was presumably made in 1927. His conclusions were definitely pessimistic: “almost one half of them die during the first year

¹ These figures cannot, however, in any way be considered as a norm for conditions in Germany, since only those women were admitted to our obstetric department who were found at a preliminary examination to be healthy, and no complications were expected in the course of labour.

of life. Of those that remain alive, the majority are physically as well as mentally underdeveloped . . . In brief, the immature infant becomes the backward school child, and is a potential psychopathic or neuropathic patient and even a potential candidate for the home for imbeciles and idiots."

The main drawback to Capper's series is that it consisted principally of children born during a time of war or depression, when the population was in an exceptionally poor nutritional state, and of those from socially and economically badly situated groups. Moreover, no comparative material representative of these conditions was presented.

LOOFT in Norway published reports in 1923 and 1928 of the developmental and intelligence quotients of prematurely born children. In 1923 he gave an account of 38 children aged 3—38 months, all of whom showed signs of rickets. He used his own developmental test as the norm and made comparisons with full-term infants, both those who had had rickets and those who had not had this illness. He found that 75 per cent of the prematures were retarded as compared to the healthy full-term infants, but not in comparison to those who had rickets. He concluded that the retarded development could mainly be ascribed to rickets and that it should be transient.

In 1928, Looft reported on several additional series:

a. 91 children, aged $4\frac{1}{2}$ — $11\frac{1}{2}$ years, with a birth weight of 2500 grams or less. They were tested with the Binet-Simon-Terman test; 7 had an I.Q. ranging between 57 and 87.

b. 29 prematurely born children delivered in their home; the I.Q. ranged between 43 and 88.

c. 532 children of school age denoted as mentally deficient; in 29 cases Looft considered the cause to be prematurity. In 19 cases the I.Q. ranged between 71 and 88.

d. 15 prematurely born children who had just started school; 1 of them was mentally subnormal.

e. 105 prematurely born children from Looft's private practice as a child psychiatrist. 10 of them had intellectual disturbances only; 19 had Little's disease and 3 epilepsy, in every case accompanied by mental disturbances.

f. 150 children in an institution for the mentally deficient; prematurity was stated to be the cause in 8 cases. In other such institutions, the corresponding figure was 27 out of 717.

No generally applicable conclusions can be drawn from these series, which in the majority of cases were selected in a negative direction, since they comprised children who had been brought to a child psychiatrist, or who had been institutionalized for mental disturbances. No representative comparative figures are given. A merit of the investigation is the introduction of more objective standards of evaluation.

Another investigation from Norway was published in 1930, that of the obstetrician SUNDE in collaboration with the school psychiatrist LOFTHUS. Their original material consisted of 1143 premature infants discharged alive from a maternity hospital. Four hundred and fourteen of them could not be traced, *i.e.*, 64 per cent were traced. The follow-up examination was made on 559 prematurely born children aged 6—21 years, the majority being between 10 and 15 years of age. At the time of the investigation, 109 of them attended school in Oslo; 102 were tested with the Binet-Simon-Stanford test. The comparative material consisted of 150 children from a school in Oslo selected at random; they underwent the same tests. The mean I.Q. in the control series was 94.5 for the boys and 92 for the girls; the corresponding figures for those born prematurely were 85 and 83. The authors concluded that the intellectual development of the prematurely born children was retarded in comparison to that of the children in the normal material. No direct relationship could be demonstrated between the I.Q. and the birth weight.

The main fault that can be found with this investigation is that more than one-third of the children could not be traced. In addition, no data are given regarding the social and economic background of the two series, except that the form of schooling was the same in both cases. The great advantage is that, for the first time in such an investigation, a representative comparative series was presented.

MOHR and BARTELME's first study on the mental and physical development of premature infants was also published in 1930. It was subsequently enlarged and published in its final form in HESS, MOHR and BARTELME's book of 1934. The 1930 investigation comprised 113 prematurely born children compared with 40 siblings of some of these infants. The age of the prematurely born children ranged between 8 months and 7 years, the mean age being 2 years 9 months. The mean age of the siblings was 5 years 8 months. Two tests were used: the Gesell Developmental Schedule for 107 children less than 5 years old, and the Kuhlman-Binet Scale for 113 children over 18 months of age. In both cases the chronological age was corrected for prematurity. The later investigation comprised 250 children selected at random among those attending an out-patient clinic for prematurely born children. The controls consisted of 152 full-term siblings from 108 families with premature infants. Their age ranged between 1 and 9 $\frac{1}{2}$ years. The children were from a slightly lower social and economic group than the norm. The follow-up examination was made in the same way as in the 1930 investigation, except that the I.Q. of all the children was recorded and the Gesell Schedule used for all those below 6 years of age.

The authors concluded that, if the degree of prematurity was taken into consideration, there was no reliable difference between the prematurely

born children and their siblings with a normal birth weight. This also applied in a comparison with the norms for the tests. The Gesell Schedule showed a tendency to retardation during the first two years of life, if the chronological age was not corrected. No statistically significant correlation was present between the birth weight and the I.Q. Nor was any statistically significant difference found between the children of healthy mothers and of those who suffered from toxæmia, renal complications or syphilis during pregnancy. A tendency to retarded development was found in 69 children who had presumably suffered slight brain damage during birth. There was a higher incidence of nervous symptoms among the prematurely born children than among their full-term siblings.

The merits of this extensive investigation are obvious. The social and economic factors were taken into consideration by means of satisfactory comparative material. Objective methods were used for the tests. The children were under observation for a long period and were familiar with both the examiners and the surroundings.

The objections that can be raised are negligible in comparison to the merits. For example, the series was stated to be "selected *for the most part* at random" but no details are given. The clientele at a follow-up clinic for prematures usually consists of children who have suffered birth injuries and of those whose mothers are ambitious, in particular when the child in question is their first child or first premature child. The number of premature children born out of wedlock is, at any rate according to Swedish standards, extremely low, *i.e.*, 8 out of 250. Five-sixths of the children were followed up only until they were of school age.

In 1934, another study was published in the U.S.A., that of ROSANOFF and INMAN-KANE. Among other matters, they investigated the number of prematurely born children among mentally defectives as compared to an unselected population. They found an incidence of 21.31 per cent among 122 in the former category, as compared to 3.89 per cent in a normal population of 9 782 persons. They also investigated the incidence of mental deficiency among prematures as compared to an unselected population. Of 347 prematures discharged from the maternity department, 146 could be traced. In 140 cases intelligence tests were made; 10.27 per cent were found to have an I.Q. below 75, 17.9 per cent below 85 and 19.3 per cent above 115. The median was 100. In Terman's group of 905 unselected children, 11.55 per cent had an I.Q. above 115. Rosanoff and Inman-Kane concluded that prematurity is an aetiological factor in mental deficiency, although in the majority of cases it is due to birth injuries, which are more common among prematures.

The criticisms that may be made of this study are mainly that only 42 per

cent of the children could be traced and that data concerning the social, economic and genetic background are lacking.

In 1935, the Dutch obstetrician DUYZING reported a follow-up study of 712 prematurely born children, selected according to the length of pregnancy without consideration to the birth weight. The children were born during the 28th up to and including the 37th week of pregnancy and a number of them weighed over 3000 grams at birth. The age at the follow-up examination ranged between 7 and 26 years. A calculation of how many of the 1450 liveborn infants survived the 10th day of life gives the figure 1145; 340 appear to have died later and 712 were examined, *i.e.*, approximately 92 per cent were traced. The follow-up examination consisted of a written questionnaire, personal examination, statements regarding the achievements at school and, in the few cases over 20 years of age, regarding military service. Of these 712, 42 were considered to be mentally subnormal and 5 imbecile, *i.e.*, 6.6 per cent were mentally deficient. As a comparison, 2 per cent is given as the mean figure for the German population. In the 47 cases of mental deficiency, hereditary traits were considered to be present in 33 cases, to be absent in 9 cases and in 5 cases the genetic investigations were not complete. The authors concluded that although mental deficiency is more common with a low birth weight and shorter pregnancy, prematurity in itself is of little importance but that genetic factors play the decisive role.

The main objections that can be raised to this extensive study are the following. Primary figures are seldom given for calculations of the incidence. No comparative material typical of the social class and environment is presented. The series includes an unspecified number of children with a birth weight ranging between 2500 grams up to over 3000 grams. The data regarding hereditary traits and other genetic factors must be considered as insufficient. A stringent genetic analysis must be made far more thoroughly.

A preliminary report was given by BRANDER in 1935; it was published in its definite form in 1936. The series comprised 376 prematurely born school-children aged from 7 to 15 years. Of the 1070 who had been discharged alive, 240 had died later and 583 could not be traced, *i.e.*, 77 per cent were traced. The Binet-Simon-Terman test was made in 376 of these cases. The social and economic background of the children must be denoted as exceedingly poor. The mean I.Q. was approximately 85. When those prematures with hereditary traits, complications during delivery or both these factors were excluded, 230 children remained; it was found that the lower the birth weight, the lower was the I.Q. Brander stated that he found a rectilinear relationship between the I.Q. and the birth weight, so that a difference of 500 grams in the birth weight corresponded to 7—8 units in the I.Q.

Much attention was accorded to Brander's study and in all the subsequent

discussions it has been contrasted to the findings of Mohr and Bartelme. The questionable features are that the social and economic situation of the children was poor and that the material was selected to some extent, in that there was a high incidence among the parents of alcohol addicts and of unmarried mothers. Moreover, a control series was lacking and 23 per cent of those who were discharged alive from the maternity department could not be traced.

Of the publications later than Brander's, I shall only discuss those in which the follow-up series consisted of more than 100 cases and those which, despite a smaller series, made some new contribution to the discussion.

SIEDENTOPF (1937) gave an account of a follow-up examination of 188 prematurely born children; only a relatively small percentage could be traced of those who had left the maternity department alive. The age at the examination ranged between 10 and 14 years. A personal examination was made in 100 cases; in the remainder information was obtained from replies to a written questionnaire. The mental development was assessed mainly on the school reports, which were considered to be a better basis than the I.Q. on a single occasion. The achievements were denoted as good in 34.6 per cent, moderately good in 46.3 per cent and poor in 19.1 per cent; 14.3 per cent of the last-mentioned category were unable to follow the ordinary instruction at school. A comparison was also made between 100 prematures born in wedlock and 88 born out of wedlock. In the former category there were 46 per cent good pupils and 15 per cent poor pupils; the corresponding figures for the children born out of wedlock were 21.6 per cent and 23.9 per cent.

The objections that may be raised to this investigation are that no objective methods were used for the testing and that no normal figures were given. The comparison between those born in and out of wedlock, respectively, is of interest but the series are relatively small. Nor were any normal figures given for this part of the investigation.

SCHÖBERLEIN published in 1938 a study of premature infants all born in a maternity hospital and in wedlock; the age at the follow-up examination was between 6 and 18 years. Altogether 275 such infants were discharged from the hospital but only 96 could be traced. Almost half of them weighed less than 1 500 grams at birth. The follow-up examination was made by means of questionnaires addressed to the parents and teachers and Binet-Simon-Terman tests.

The author concluded that the I.Q. rises with an increase in the birth weight. Of those examined, 3 were mentally subnormal and 3 imbecile, *i.e.*, altogether 6.3 per cent of the whole material. According to the teachers, only those children with a birth weight of more than 1 500 grams were above the normal intellectual level. The mothers described the children, particularly those with a very low birth weight, as irritable and nervous.

In this study, the percentage of children that could not be traced was remarkably high, and no representative control series was described.

BEITEL reported in 1939 on a follow-up examination of 119 prematurely born children. The age ranged between 0.8 and 6.5 years, the majority being between 2 and 4 years old. In order to avoid the influence of hospitalism, those who had latterly been cared for in institutions were not included. From an economic and social point of view, the series was on a fairly high level. Fifty per cent of the children came from working-class homes and 4 per cent were born out of wedlock; 97 per cent lived at home. The examiner was not previously acquainted with the majority of the children but good contact was stated to have been established in 80 per cent of the cases and no difficulty in carrying out the examination was encountered in the remaining cases. The Bühler-Hetzer test was used; 12.5 per cent were found to be above the normal level and 29 per cent below. Beitel also divided her series into other groups in order to permit comparisons in tabular form with the results of both Mohr and Bartelme and of Brander. The author summarized her views in the statement that after the age of three years the I.Q. of the prematurely born children corresponds to the norm for the test. She found only a slight relationship between the I.Q. and the birth weight. Beitel stated that she found a relatively more rapid mental development during the first years of life; in this respect her views agree with those of Gesell.

The main criticism that can be made of this investigation is that the children were followed up for only a short period and that no representative comparative series was presented.

In 1939, SCHULZE published an account of a follow-up examination of 160 prematurely born children; they comprised those who could be traced out of the 382 who were discharged alive from the maternity department. At the time of the examination, the age ranged from 8 to 13 years. A personal examination was made in 97 cases and information about 63 was obtained from a written questionnaire. A comparison was made with their siblings with respect to weight, height and general impression. Forty per cent of both the prematurely born children and their siblings were below the normal physical and mental level. Cerebral disorders were present in 4.8 per cent; this included 1 case of mongolism and 1 of microcephaly.

In this investigation, the number traced was somewhat small and no objective methods of examination were used.

The first large investigation after World War II was published in 1945 in England by BARLOW. The follow-up examination was made on a series of 514 prematurely born children; 255 of them were taken from the out-patient material of the hospital and 259 were private patients. The control series consisted of 149 full-term children from the out-patients' department and 352

full-term private patients. Mental abnormalities of some kind were found in 33.6 per cent of the prematures, the corresponding figure for the controls being 11.2 per cent. When both series were divided into four weight groups, the percentage deviations remained unchanged in all the groups in the control series, but rose from 31.2 per cent to 64 per cent with a decrease in the birth weight in all four groups of prematures. Between 6 months and 3 years of age, 42.6 per cent of the 244 prematurely born children were "abnormal" as compared to 19 per cent of the 174 controls. Of the total 173 prematures denoted as "abnormal," 11 were mongols and 17 had various disorders, some of which must be considered as a cause of prematurity rather than as a result of it.

The objections that may be raised to this investigation are those most frequently occurring, *i.e.*, that the material is selected and that no information is given concerning the social and economic background of either the prematurely born children or the controls. In the former category, 50 per cent derived from the out-patients' department of the hospital, whereas in the latter category the figure is only 30 per cent. The remaining 50 per cent and 70 per cent, respectively, were denoted as "private patients" but no account was given of the social and economic implications. At the follow-up examination, 47.5 per cent of the prematurely born children were from 6 months to 3 years of age; the corresponding figure for the controls is 34.7 per cent. Even those authors who are optimistic regarding the prognosis for prematures agree that the prematurely born children have not reached the level of the full-term infants by this time. In addition, as in the majority of investigations, Barlow did not distinguish between those pathological conditions that may cause prematurity and those that may be a result of it.

In 1946, another report was published in England. ASHER planned a follow-up study of 205 prematurely born children who were discharged alive from a children's hospital. Only 58 of them could be traced and examined and a further 8 were found to have died. Thus, information could be obtained about only 32 per cent. This was ascribed by the author to the constant change of residence during the war, particularly in the industrial areas. In order to increase her series, Asher included premature infants who had been admitted to the hospital on other grounds than prematurity or those who were registered at the child welfare centres. With these additions, her series consisted of 217 prematurely born children. Those under 3 years old were tested with the Gesell Developmental Schedule and those over 3 years with the Binet-Simon-Stanford test. The results were calculated with correction for the chronological age.

It was found that the prematurely born children below 3 years of age were 1—2 months retarded in their development, whereas the mean I.Q. for those

of 3—6 years old was 92—93. The author stated that there was a direct relationship between the birth weight and the I.Q. She concluded that there are four types of prematures: (1) those who reach the same level as full-term infants during their first year of life; (2) those who develop slowly but gradually attain the normal level; (3) those who are mentally subnormal and thus never reach the normal level; (4) those with Little's disease or other nervous motor disorders.

It may be objected that the percentage traced was low, but this applies to all similar investigations made after 1945 in the European countries involved in World War II. Asher's complementary material was presumably selected to some extent, since it was taken from hospitals or from institutions for prophylactic child welfare. Moreover, her material derived from a large manufacturing town with its particular social and economic problems.

In 1948, DRILLIEN published a report on 103 prematurely born children compared with 174 full-term children from the same hospital. She sent questionnaires to the parents of 285 prematures and 430 full-term children, selected at random 1 out of every 10. Replies were received in approximately 40 per cent of the cases but it was not possible to ascertain the number of deaths. The children were followed only until the age of $1\frac{1}{2}$ to $4\frac{1}{2}$ years. The main interest was focused on the conditions during the first years of life. The children were not tested, but 15 per cent of the full-term infants and 23 per cent of the prematures were stated to exhibit behaviour disorders. Drillien expressed the opinion that the difference between the respective categories after the first years of life was dependent upon the environment, and that the same factors were operative post-natally as pre-natally.

The following points may be raised. The number of children traced was small, the observation period was short, and no objective tests were made of the mental development.

An extensive study was published in Sweden in 1949 by BESKOW. It consisted of follow-up examinations of 273 prematurely born children between the age of 9 and 17 years. The incidence of those traced was 92.1 per cent. The social and economic situation was denoted as extremely poor; 60 per cent were born out of wedlock. The home conditions were deplorable in 10 per cent of the cases and in 12 per cent the father was an alcohol addict. Scarcely 50 per cent of the children came from an "irreproachable environment." The Terman-Merrill test was used and the results compared with the mean figures for the schoolmates. The children were tested at intervals of one year and the results analyzed to exclude pseudo-oligophrenia on the grounds of speech retardation or poor motor development. Twenty-five per cent of these children had been referred to a child guidance clinic for difficulties at school (difficulties in following the instruction in 49 cases, reading disability in 3

and pronounced nervous disturbances in 16 cases). The I.Q. was below 85 in 16.11 per cent of all the prematurely born children and below 60 in 4.76 per cent; one child was considered to be ineducable. There was a definite history of a cerebral haemorrhage in 6.59 per cent of the cases. If these children and those with mentally abnormal parents are sorted out from those with an I.Q. below 85, this group had a somewhat lower I.Q. than the remaining children, *i.e.*, 2 units for the boys and 4 units for the girls. Beskow was unable to confirm Brander's observation of a direct relationship between the I.Q. and the birth weight, but found the I.Q. to be independent of the birth weight in the prematurely born children.

Epilepsy was present in 3 of the children and spastic paralysis in 9. These children comprised half of those who had been suspected to have had a cerebral haemorrhage at the maternity hospital. The incidence of manually unskilful and nervous children was extremely high. The children born in wedlock did better at school and had a lower incidence of nervous symptoms than those born out of wedlock.

In 1947, BESKOW published a study on the distribution of nervous symptoms in children during the first years of life. He gave an incidence of 32.5 per cent for children with a normal birth weight, whereas the corresponding figure for prematures was 66.6 per cent.

The advantages of Beskow's study are the high incidence of those traced and the thoroughness of the observations. A disadvantage which makes it difficult to draw any generally applicable conclusions is that the social and economic background of the children was exceptionally poor. Moreover, no control series typical of the same conditions was presented, but the comparisons were made with the mean figures for schoolchildren in general.

HESS, LUNDEEN, KUNDSTAEDTER and ENGLE reported in 1949 on 259 prematurely born children with a birth weight between 735 and 1260 grams, who had been discharged alive from the Premature Station of the Sarah Morris Hospital in 1922—1947. Of those discharged, 33 had died later and 10 could not be traced, *i.e.*, 96 per cent could be traced, which is an exceptionally high figure for an investigation of this nature. A follow-up examination was made of 216 patients; 188 were white and 28 coloured. Twenty-four were 17 years old or above; 3 of them had completed their military service. The children were classified into five groups according to the physical and mental development, with the following results:

	Physical Development	Mental Development
Normal average — some superior	101	123
Slight deviation	68	54
Poor	20	21
Bad	20	6
Extremely subnormal	3	5
	212	209

Of the 59 children with a suspected cerebral haemorrhage, 28 showed no signs of residual defects, whereas in the remaining 31 cases the symptoms were slight in 1, moderate in 10 and severe in 20 cases.

In this investigation, the main interest was focused on the small prematures. An extremely high percentage was traced and the follow-up period covered many years. On the other hand, the test methods were somewhat approximative and no account was given of a comparable control series from the environmental and social point of view.

In 1950, KOENIG published a report of a series of 700 prematurely born children whom she had followed up by means of annual visits to the out-patients' department for prematures. Thus, 150 children with a birth weight below 2 kilograms and 500 between 2 and $2\frac{1}{2}$ kilograms were followed up until the age of 2—10 years. The material was also divided into sub-groups in order to ascertain whether there was any borderline below which no particularly high values were found. The children were found to have attained normal height and weight by the age of six years or even earlier. Intelligence tests were made in 28 cases selected at random (the children happened to visit the clinic on those days on which the psychologist was in attendance). Using the Binet-Simon tests, the I.Q. ranged between 83 and 124. An additional 99 children were tested with the Otis Alpha form A. The quotients ranged between 66 and 137; these were stated to be no lower than those of schoolchildren in the same town with the same background. Even those children with a birth weight below 2 kilograms obtained good results.

Koenig made no mention of how many children were discharged alive from the hospital. Nor did she state the percentage of children who returned for follow-up examinations nor whether there was a preponderance of any particular type of prematures among those attending. In addition, representative control material was lacking.

A paper by the Frenchman SCHACHTER was published in 1950 in an Italian journal. The report was based on the follow-up examination of a child weighing 860 grams at birth, but an account was also given of an examination of 183 prematurely born children brought for consultation on the grounds of mental disturbances. No mention was made of their age. On the basis of the Binet-Simon tests, 41 per cent were denoted as normal, 28 per cent as borderline cases and 31 per cent as definitely mentally subnormal.

Only a brief account is given of the series and no generally applicable conclusions can be drawn, since the investigation was confined to those who were brought for examination on the grounds of behaviour disorders or mental subnormality.

In 1951, BRUSA and MENGHI of Italy reported a study of 543 "immature" children (birth weight 2500 grams or less) followed up for 4—14 years. Rela-

tively few of them were small prematures, *i.e.*, only 10 weighed less than 1500 grams. The authors stated that the mortality was high during the first two years of life but that subsequently it was comparable to that among full-term infants. They found that the physical development soon reached normal standards. The mental development was normal in the majority of cases. They denoted 31 children as being moderately mentally deficient and 3 as imbeciles, but did not state the criteria used. The incidence of those born out of wedlock was 15.65 per cent. All the children were born or lived the first years of their life during World War II. No control series was studied. No general conclusions can be drawn from this investigation.

LEVESQUE and COFFIN in France published an account in 1951 of 95 personally examined prematurely born children. They received replies to 300 out of 600 questionnaires. "Troubles de caractère" of varying degrees were present in 46 cases. The I.Q. was determined in 60 children aged between 3 and 12; 24 were of normal intelligence or above, 25 were one year below the normal, 8 two years below and 3 were denoted as imbeciles.

Few inferences can be made from this study, since the number of cases missing is too large and no control series is reported.

In 1952, another investigation was published in Norway, namely that of BLEGEN. She reported on a large series, taking into consideration not only the immediate mortality but also the physical and mental prognosis up to and including school age. The mental examination covered 541 prematurely born children between the age of 8 and 17 years. They comprised those that could be traced out of the 893 liveborn children; 682 were presumably alive at the time of the investigation. Thus, only 79.3 per cent could be traced.

The children were tested with a group test during their first year at school. On this basis and the teacher's general evaluation, all those who appeared mentally retarded were picked out; after a special physical and psychological examination, they were assigned to a suitable form of schooling. According to the text, all those who attended an ordinary elementary school and did not require a special examination had an I.Q. above 80. According to the tables, however, they should have had an I.Q. of over 90. She found the following distribution:

I.Q. >90 476 children (presumably a printer's error, since the figure should be 474)

I.Q. 81—90	15	»
I.Q. 71—80	27	»
I.Q. 51—70	18	»
I.Q. 36—50	4	»
I.Q. 35	3	»

Thus, 4.6 per cent had an I.Q. of 70 or less. A follow-up examination of the children attending the ordinary classes was made by means of a questionnaire addressed to the teachers. Blegen found that the social background was an extremely important factor and that the prematurely born children often had a poorer social and economic status, judged according to the housing conditions, than schoolchildren in general. She stated that an improvement in the social background and in the housing conditions would presumably result in better mental development.

The criticisms that may be made of this investigation are the following. The incidence of children traced was relatively low. No study was made of a control series of full-term children with a comparable social background. The use of the number of persons living in each room as the main basis for the social classification appears to be somewhat questionable, particularly in view of the post-war housing shortage. Even if the conditions referred to the pre-war years, it seems that a more satisfactory basis for the classification might have been chosen.

In 1952, HOWARD and WORRELL reported on a follow-up examination of 22 prematurely born children with a birth weight up to 1820 grams. The age at the examination ranged between 8 and 19 years and the main interest was focused on the development of the intelligence and personality. The physical development was stated to be normal in the majority of cases, although errors of refraction were more common than could be expected in normal children. Four different tests were used for the mental development. The resulting curve for the distribution had a normal appearance; two of the children had an I.Q. of 130 and 132, respectively, and two had an I.Q. of 55 and 56, respectively. Delivery had been difficult in 5 out of the six children with an I.Q. between 70 and 80. The authors concluded this to be an indication that prematurity does not affect the mental development. They found no correlation between the degree of prematurity and the intellectual capacity. They recommended that attendance at school of prematurely born children should be delayed for one year.

Several of the children appeared, owing to emotional maladjustment, to have difficulty in taking advantage of their possibilities. Two personality tests were used on 21 of the children and the results compared with the opinion of the parents. Five children had earlier been under the care of a psychiatrist for difficulties in adjustment. The authors concluded that the "emotional instability" noted was increased by the overprotective attitude of the parents, the initial poor physical development and possibly by "the rigid type of immediate postnatal care"; during this period these children lack the ability to express their wants.

The article presents many interesting features, but has the disadvantage of being based on a large number of examinations on a small series.

In a lecture given in 1952, AHNSJÖ reported on a series of prematures in Stockholm. It has hitherto only been published as a review by the author. The series consisted of 374 prematurely born children admitted between 1945 and 1951 to the Home of the Child Welfare Authorities of the City of Stockholm (Nybodahemmet). The age of the children at the examination ranged between 1 and 15 years. Although the series was relatively small, it was divided into twins and single births. It was then classified further into five groups according to the presence or absence of complications during delivery (K), hereditary factors (H) and environmental factors (M). No mention is made in the review of how the two last-mentioned factors were defined. The resulting groups were, for example, H-K-M-, or H-K-M+. A comparison was then made between each group of prematures and a control group, as far as possible identical, consisting of children born in the same year as the prematures and with a birth weight of more than 2500 grams.

The mean values for the motor functions of the prematurely born children in group H-K-M- (for which the calculated length of prematurity was given) showed a retardation corresponding to the time the child was born before calculated term. The prematurely born children with a birth weight below 2000 grams, on the other hand, showed a greater retardation than that corresponding to the degree of prematurity.

In a smaller series, in which the Bühler-Hetzer and Terman-Merrill tests were used, the children with a low birth weight, in groups H-K-M- and H-K-M+ also showed, as a rule, I.Q.s within the normal limits. The majority of low I.Q.s were noted in children of pre-school age.

A higher incidence of nervous symptoms was also found in group H-K-M- of premature single births than in the group of premature twin births and the controls.

Drawbacks from a social and economic point of view are usually associated with a series consisting of institutionalized children, when it is to be used as a basis for more generalized conclusions. These have been compensated for in Ahnsjö's study by the use of a control series comparable from the majority of aspects. Since severely mentally deficient or crippled children are usually placed in institutions appropriate for their care, very few of these cases can have been included. It may, however, be presumed that in the majority of cases such children would have belonged to the groups with H+ or M+. In this case, they would not have been assigned to groups H-K-M- or H-K-M+ discussed in the foregoing.

4. Summary

In order to summarize the literature and to record the aspects of the relevant problems on which opinions are unanimous and those on which opinions are at variance, I have drawn up the following points.

It is generally agreed that:

1. The physical and mental development of prematurely born children is retarded during the first two to three years of life. This retardation is most marked in children with a particularly low birth weight. If the time before calculated term at which the child is born is taken into consideration, and a corrected chronological age is used, the retardation is less marked.

2. In the majority of investigations on the prognosis for premature infants, the incidence of severe mental disturbances is stated to be relatively high. Only a few studies have failed to report a high incidence. According to a survey of 19 articles made by PEIPER (1937), such disturbances are found in 5.5 per cent of prematurely born children.

3. As early as the beginning of the present century, nervous disturbances were stated to be more common in prematurely born children than in those born at term. These symptoms may be psychosomatic (*e.g.* increased fatigability, disturbances of sleep), emotional (*e.g.* anxiety, shyness, irritability, emotional outbursts) or intellectual (*e.g.* short span of attention, poor memory, lack of concentration).

4. Prematurely born children are more often motorially clumsy and relatively often exhibit speech disorders or reading disability.

The points on which opinions are extremely divergent are mainly the following.

1. At what time is this retarded development, both physical and mental, compensated and is it ever compensated, even in children who have suffered no birth injuries?

2. Is there any direct relationship between the birth weight and the mental development and, if this is the case, how strong is the correlation?

The answers given to these questions by the various investigations are, in some cases, diametrically opposed. Moreover, practically all the shades of opinion between these two extremes are represented in the literature.

The question arises of the reasons for these discrepancies. As far as I have been able to ascertain, the main reasons are the following.

- a. For more than thirty years, prematurity has been defined by means of a borderline figure partly dependent upon the decimal system. The introduction of this borderline figure constituted a considerable advance, since still more vague conceptions had been in use earlier. The investigations of prematurely born children published during the past 20 years have given increasing

evidence of the heterogeneity of the term prematurity. Actually, the birth weight is affected by *genetic* factors such as descent from various types of isolates. It is, for example, possible that the mean figure for the birth weight varies for different races. It has also been shown that, in certain families, all the children have a low birth weight on no demonstrable medical grounds. There is also a definite difference between the birth weight of boys and girls. The birth weight is also affected by *social* and *economic* factors. These may result in a difference in the nutritional state of the mother during pregnancy. In addition, such factors as heavy work until parturition and varying degrees of mental stress are present in some cases. Only in half of the cases is there an established medical cause of the low birth weight. Of the *obstetric* factors, the most common are presumably various forms of proteinuria, haemorrhages, acute infections, syphilis, endocrine disturbances and purely mechanical obstetric abnormalities and multiple births. *Paediatric* factors, such as malformations and mongolism, also affect the birth weight.

In comparing the results of different authors, the following fact must be borne in mind. A comparison is made between series from countries with entirely different social standards, from towns with widely divergent social structures, from maternity departments with extremely different incidences of premature births and premature mortality, from periods with different birth rates, from war-time and peace-time series. Other differences may also be found.

b. The main source of uncertainty is the following. To what extent is demonstrable mental subnormality a result of combined genetic and social factors, which have led to both a low birth weight and to poor intellectual development evaluated during pre-school or school age?

c. When it is a question of neonatal mortality or of mortality during the first year of life, it is not customary nowadays to publish series of less than 100 cases. When the problem arises of the importance of a low birth weight for the future of the individual, generalized conclusions are often drawn from small series which are subject to large random errors. Moreover, the grounds for the evaluation vary appreciably. Comparisons are not infrequently made between different series of prematurely born children, or between the results obtained for such children and the mean values for schoolchildren of the same age with a normal birth weight. It is not always borne in mind that the respective series may be selected, in that children with an I.Q. below a certain level are not represented in the control series. Moreover, it is unusual to find a report of a control series comparable with regard to the environment and the period of time.

Certain conclusions may obviously be drawn even from relatively small series that are unsatisfactory from certain points of view. However, it is im-

possible to disregard the fact that — one hundred years after the question was first raised in the medical literature — certain essential problems regarding the importance of the low birth weight for the future of the individual have still failed to receive a generally accepted answer. The present investigation is therefore an attempt to approach the problem to some extent on different lines to those previously used.

CHAPTER III

Scope of the Present Investigation

1. The Problem

The following general principles were drawn up for the investigation:

1. The number of prematurely born children in the series should preferably be considerably larger than in earlier investigations.

2. The basic material should be relatively uniform. For this reason, the lowest social stratum should not be included. This was in order to exclude, to some extent, the most markedly unfavourable factors from a genetic and socio-economic point of view.

3. The observation period should be sufficiently long to permit an evaluation of the final social adjustment of those followed up. Previously, the attempts have been confined to an evaluation, some time during childhood, mainly of the motor and mental functions that are only part of the prerequisites for future social adjustment.

4. The follow-up investigation should be based mainly on a search through state and communal records. In these records, the birth weight is not the determining factor and may therefore be considered as an objective evaluation. When going through the records, the examiner should have no advance knowledge of whether the subjects were prematurely born or had a normal birth weight.

5. The comparative material should consist of a comparable control series from the same maternity hospital and from the same period of time, *i.e.*, so-called social twins.

6. The follow-up investigation should, if possible, be made so thoroughly that reliable information could be obtained about every subject in both series. This should be feasible in Sweden, since the country has not been at war for over one hundred years and national registration has been in force for more than two hundred years. This should be particularly easy during and immediately after rationing, as it was necessary to be registered for census purposes in order to obtain ration cards for the most essential foodstuffs. Moreover, infant mortality has always been low in Sweden and, with the exception of the influenza pandemic in 1917 to 1918, we have had no severe epidemic during the present century.

Sweden maintained a strong defence force in 1939 to 1945. All those liable

to conscription, *i.e.*, born between 1902 and 1921 inclusively, were either called up for repeated periods or, if they had earlier been exempted, were re-examined. Thus, the military data with regard to the physical condition and military fitness are particularly complete and up to date.

7. Information concerning those followed up should, if possible, include both positive and negative factors. This would avoid giving — as has most frequently been the case — only the number of extreme negative deviations from the norm.

The points that I have stressed in the foregoing as being of great advantage in a series obtained in this way obviously imply certain limitations. In the present investigation they were the following.

1. In order to obtain a sufficiently large series and an adequate observation period, the series had to derive from the beginning of this century.

2. In order for the information regarding the birth weight to be reliable, the series had to be assembled from maternity hospitals. During the period in question, 50 to 75 per cent of the parturient women in Stockholm were delivered at a maternity hospital. This involved an over-representation of mothers living in poor housing conditions, unmarried mothers and expected complications during delivery. On the other hand, one of the maternity hospitals in question had a private ward during the whole period and another during part of the period.

3. In order to obtain a more uniform series, it was necessary to confine the investigation to children of mothers registered for census purposes in Stockholm in the year before the birth of the child.

4. The investigation was confined to male subjects. This was because it appeared more likely that information would be found about men than about women in a number of the records to be consulted, *e.g.* the Central Conscript Bureau (*Centrala värnpliktsbyrån*), the Inland Revenue Office (*Skatteverket*), the National Liquor Control Board (*Kontrollstyrelsen*) and the Penal Register (*Straffregistret*).

5. Initially, both children born in wedlock and those born out of wedlock were included, but the investigation was finally confined to the former category. This limitation was made for the following reasons. At the beginning of the 20th century, the children born in wedlock represented a higher social stratum. The number of children born out of wedlock has always been high in Sweden. Between 1901 and 1920, such children comprised 30 per cent of all those born in Stockholm and 13.8 per cent of those born in the whole country. During the same period, they comprised 48.3 per cent of all the prematurely born children discharged alive from the three maternity hospitals in question. The mothers of children born out of wedlock nearly always represented those worst situated in the community. Considerable difficulties

were encountered in attempts to trace them in the same way as the children born in wedlock. The mother not infrequently married another man and the child was known by his surname. In other cases, the children were placed in orphanages or in foster-homes and adoptive homes all over the country. At the beginning of this century, the name of the unmarried mothers was not recorded in the birth records at one of the maternity hospitals in question. Moreover, the mortality was considerably higher among the premature infants born out of wedlock than among those born in wedlock.

In addition, the inclusion of the children born out of wedlock would not have contributed any new feature to my original problem. It would only have made it more difficult to ascertain the importance of the birth weight for the social prognosis. Finally, as mentioned earlier, I did not wish the series to be composed of the children of those worst situated in the community. This would have made it more difficult to evaluate the social variations in a negative direction.

6. Only those prematurely born children discharged alive from the maternity hospital were included. The number of liveborn prematures excluded in this way corresponds approximately to the deaths during the first 14 days of life. I did not consider it worthwhile to make a study of the mortality among prematures during the first weeks of life on the basis of case records 25 to 45 years old. At that time, the data regarding the post-natal state of the child were relatively scanty, and post-mortem examinations were seldom performed on children who died at an early stage.

2. Planning of the Investigation

The two series to be studied were assembled as follows. I went through the birth records at Allmänna Barnbördshuset, Södra Barnbördshuset and Pro Patria from 1902 to 1921 inclusively. These three maternity hospitals were the only ones of importance in Stockholm during the period in question. They will be denoted in the following as ABBH, SBBH and Pro P, respectively. The year 1902 was selected because bound volumes of the records of SBBH existed from this year. I went through altogether 115,980 birth records.

Data concerning the subjects whose development I wished to study were taken consecutively from the records and entered on a separate card for each subject. White cards were used for the basic series and green for the control series; in other respects the cards were identical.

The basic series consisted of all the male children born in wedlock with a birth weight of 2500 grams or less, who had been discharged alive from the

maternity hospital, and whose parents were found in the parish registers of Stockholm in the year preceding their birth.

The control series was assembled as follows. Corresponding to each case in the basic series, I took the boy with the next following case-record number at the same maternity hospital, with a birth weight from 2760 grams up to and including 3750 grams, who had been discharged alive from the hospital, who had been born in wedlock and whose parents were found in the parish registers of Stockholm in the year preceding his birth. These borderline figures for the weight were taken because the mean birth weight for boys was stated to be approximately 3250 grams at the beginning of the century, and I considered it appropriate for the children in the control series to have a birth weight close to the mean.

The following data were entered on the card. — The case-record number at the maternity hospital. — The date of birth. — The name, occupation of the parents and their address. — The majority of children had been christened at the hospital; the christian name of the child could then be obtained from the case record. — Weight and length at birth. — Age of the mother, parity number of the child and the condition of the mother during pregnancy. — All available data regarding the course of delivery and of the child's condition at the hospital. — A calculation (whenever the necessary data were available) of how many weeks before or after calculated term the child was born. — About 20 items were obtained from each record.

The disposition of the birth records differed in all three hospitals and was changed several times during the 20-year period. The data taken from them were therefore checked three times in order as far as possible to exclude faulty transcriptions. Relatively many errors were found in the actual records; this applied in particular to the spelling of the names or the order of the christian names. This led to considerable difficulties in the subsequent identification of the subjects and it was necessary to check with the baptismal registers. The information contained in the baptismal register with regard to the parents is taken from the extract from the parish register that must be presented by the mother at the maternity hospital. Notification to the parish authorities is made according to the entries in the baptismal register. Possible errors are cleared up and corrected in this book.

This check with the baptismal registers disclosed that a number of the unmarried mothers who lived with the child's father had used his surname. In other cases the mother had given a temporary address in Stockholm instead of the address under which she was recorded in the parish register. In the early stages of the investigation, only the subject's name and that of the mother were noted. In many cases this proved inadequate for subsequent identification. In such cases, the baptismal register — but not the hospital

record — provided the name of the father and his date of birth, as well as the exact date on which the family moved into the parish.

When these data had been entered on the cards, they were turned over to the Census Registration Office of the City of Stockholm to be checked with the current address register. This has been in existence since 1926 and lists all those persons who were then or subsequently registered for census purposes in the City of Stockholm. When a subject was found in this list, I obtained his last or present address in Stockholm, his occupation, conscript number, possible change of surname by deed-poll¹ and, when applicable, the date and cause of death. If he had moved from Stockholm after 1926, information was given concerning the date and the address to which he had moved and whether he had once more become resident in Stockholm. In the latter case, his address and date of taking up residence were supplied.

Considerable work was involved in tracing those who were not found in this address register. The register of the parish in which the subject was born was first consulted; inquiries were then made (usually by letter) in all the parishes to which he had subsequently moved. In practically every case, the subject could be traced until January 1st, 1948. If he had died before this date, the date and cause of death were ascertained.

The reason for which some subjects could not be traced, although their disappearance was presumably only apparent, was the following. A number of families had obtained a certificate of altered residence but had failed to move to the place in question. Their plans had presumably changed and they took up residence in a different place. During the first years of the century, it was not incumbent upon the authorities in the parish to which the move had been made to inform the parish in which the person had previously been resident of this move.

Persons who continue to be registered in a parish although they no longer live there, and have failed to obtain a certificate of altered residence, are — after some search has been made — transferred to the parish "list of missing persons." In the majority of cases, this disappearance was presumably only apparent and occurred before national registration reached its present effectivity. I also checked every such case with the "record of missing persons" for the whole country kept by the Central Bureau of Statistics. On practical grounds, I made no further attempts to trace those subjects who had definitely left Sweden.

¹ During the past 20 years, a considerable number of people in Sweden have changed their surnames by deed-poll. This is in order to avoid confusion, since certain surnames are extremely common. This fact greatly increased the difficulty of tracing the subjects in the present investigation.

It was possible to identify and follow up more than 98 per cent of the subjects in both series.

Both series were then listed in alphabetical order for each maternity hospital separately and the following data noted. Hospital record number. — Complete surname and christian names and, when applicable, change of name by deed-poll. — Date of birth. — Parish in which born. — Last known address. — Conscript number. — The lists were then sent to the various state and communal organs in order to check in their records, which are usually arranged alphabetically, those subjects registered before January 1st, 1948.

The following registers were consulted; the first four cover the whole country and the last four the City of Stockholm only:

1. The Central Conscript Bureau (*Centrala värnpliktsbyrån*).
2. The Penal Register of the National Prison Board (*Kungliga Fångvårdsstyrelsens straffregister*).
3. The Statistical Department and Penal Register of the National Liquor Control Board (*Kungliga Kontrollstyrelsens statistiska avdelning och straffregister*).
4. The Central Register of the National Pensions Board (*Kungliga Pensionsstyrelsens Centralregister*).
5. The Register of Special Classes of the Elementary Schools of the City of Stockholm (*Stockholms stads folkskolors hjälpklassregister*).
6. The Social Welfare Register of the City of Stockholm (*Stockholms stads socialregister*).
7. The Register of the Central Tuberculosis Dispensary of the City of Stockholm (*Stockholms stads centraldispensärsregister*).
8. The Inland Revenue Office of the City of Stockholm (*Stockholms stads skatteverk*).

For the Central Conscript Bureau, a special card had to be filled in for each subject, giving his conscript number and, when possible, his enrolment area. I then obtained information from the various enrolment authorities, based mainly on the military medical sheet. The following data were obtained. Height and weight on enrolment or re-examination. — Number or letter for the fitness classification under which the subject had finally been placed, which may be considered as an evaluation of his bodily constitution. — More severe illnesses (denoted by the military medical code number) during military service or such illness that had prevented him from completing military service. — Military fitness and behaviour. — Possible promotion. — I was also able to obtain additional data concerning the subject's occupation and civil training useful for military purposes.

The Penal Register of the National Prison Board supplied information regarding those subjects who had been convicted, the nature of their offence

and the sentence received. In those cases in which they were found to be without the possession of their senses at the time of the offence (Penal Code § 5:5) or without full possession of their senses (Penal Code § 5:6) this was also stated.

Information was obtained from the Statistical Department and Penal Register of the National Liquor Control Board on such matters as the persons who, since 1936, had been convicted of misdemeanours committed under the influence of alcohol or who had been treated for addiction to alcohol.

The National Pensions Board keeps a list of those persons cared for at its institutions for various diseases, and of those who receive pensions on the grounds of physical or mental disablement and who are incapable of steady employment.

Since 1905, the Elementary Schools of the City of Stockholm have a register of those pupils who attend special classes, and of the time for which they have attended them.

The Social Welfare Register of the City of Stockholm is extremely comprehensive. It contains lists of those persons who have received poor relief, unemployment relief, free hospital care, maternity allowances, children's allowances, institutional care or other financial or social help.

The Tuberculosis Bureau of the City of Stockholm has records dating from the end of the 19th century. Initially, they only included those receiving poor relief, but in recent years they have come to include all known cases notified to the Bureau on the grounds of tuberculosis, suspected tuberculosis and B.C.G. vaccination. Actually, this covers practically every case. Since 1939, acute tuberculosis is a notifiable disease.

Information was obtained from the Inland Revenue Office of the City of Stockholm regarding the "estimated taxable income" for 1947 and 1948. In reality, this is the net income of the subject during 1946 and 1947, the first of these years being tax-free in connexion with the change-over to taxation at the source. The mean figure for these two years is presumably that best in agreement with the actual conditions. Extremely few of the subjects in the series had an unearned income which affected the taxable income; the amount should therefore be an actual expression of the earned income. Information regarding the current occupation was also received from the Inland Revenue Office.

When the information from the respective sources had been assembled, it was transferred to the original cards. The data necessary for the statistical analyses were classified according to a code and transferred to a separate hollerith card for each subject. These were sorted mechanically and the tables thus obtained were submitted to statistical analyses.

3. Statistical Methods

The following statistical methods have been used in this investigation.

The standard deviation σ is calculated with the formula:

$$\sigma = \sqrt{\frac{\sum a^2}{n}}$$

where a is the deviation from the arithmetical mean (M), and n is the number of individuals.

The standard error of the mean, $\varepsilon(M)$ is obtained with the formula:

$$\varepsilon(M) = \frac{\sigma}{\sqrt{n}}$$

where σ is the standard deviation and n the number of individuals.

The standard error of a percentage, $\varepsilon(p)$ is obtained with the formula:

$$\varepsilon(p) = \sqrt{\frac{p(100-p)}{n}}$$

where p is the percentage, and n the number of individuals.

The standard error of a difference, $\varepsilon(D)$ is obtained as follows:

$$\varepsilon(D) = \sqrt{m_1^2 + m_2^2}$$

where m_1 and m_2 are the standard errors of the mean or the percentages on which the calculation of the difference is based.

A difference which is at least three times as great as its standard error is denoted as statistically significant. When the difference amounts to $2\frac{1}{2}$ to 3 times the standard error, it has, in accordance with Dahlberg's suggestion (1940), been denoted as statistically probable.

In order to obtain a more reliable standard than that afforded by the calculation of the percentages, an estimation of the risk figures according to Dahlberg's method (1939) was made in certain parts of the investigation.

CHAPTER IV

Obstetric and Paediatric Account

1. Cases Excluded

The number of records studied, relating to deliveries at the three maternity hospitals in Stockholm in question during the 20-year period 1902 to 1921 amounted to 115,980. According to these records, 1023 male premature infants, born in wedlock, were discharged alive from hospital during this period (Table 1). In the subsequent course of the investigation, it became necessary to exclude a number of cases from both the series of prematures and the control series. The exclusions were made either because the children did not fulfil the criteria set up or because they could not be traced. A survey is given in Table 2.

In the *series of prematures*, further investigations (particularly in the baptismal registers) showed that 11 children did not fulfil the criteria:

1 was found to be a girl: the sex was given incorrectly in the obstetric record.

3 were not registered for census purposes in Stockholm.

1 had died at the maternity hospital.

1 was not premature: an illegible 3 had been taken for a 2.

5 were born out of wedlock but the mother had stated that she was married.

Thus, with these 11 exclusions, the series consisted of *1012 prematurely born children*.

In the course of the follow-up investigation, the following could not be traced:

3 were stated to be missing by both the parish authorities and the Central Bureau of Statistics.

8 could not be traced: 7 of them had disappeared before 1921 and 1 between 1931 and 1935.

2 had left Sweden before they were 1 year old.

This involved the exclusion of an additional 13 cases. Thus, out of 1012 prematurely born infants, 999, *i.e.*, 98.72 *per cent*, could be traced and followed up from birth (1902—1921) until January 1st, 1948.

A similar investigation of the *control series* resulted in the exclusion of the following 5 children:

3 not registered for census purposes in Stockholm.

2 born out of wedlock.

TABLE 1

The original series of prematurely born children discharged alive from the maternity hospitals: distribution in 5-year periods and according to birth in or out of wedlock.

	No. born in wedlock	No. born out of wedlock	Percentage born in wedlock
Total No.	1 023	958	51.6
<i>Years</i>			
1902—1906.....	192	242	44.3
1907—1911.....	258	291	47.0
1912—1916.....	328	239	57.8
1917—1921.....	245	186	56.9
<i>Maternity hospital</i>			
Pro P	92	19	82.9
ABBH	331	348	48.8
SBBH	600	591	50.4

TABLE 2

Cases excluded from the original series of children born in wedlock.

Maternity hospital	Prematures		Controls	
	Total no.	No. excluded	Total no.	No. excluded
Pro P	92	3	92	3
ABBH	331	10	331	7
SBBH	600	11	600	11
Total	1 023	24	1 023	21

With these 5 exclusions, the control series thus originally consisted of *1018 children*.

In the course of the follow-up investigation, the following could not be traced:

5 were declared missing by both the parish authorities and the Central Bureau of Statistics.

6 could not be traced: 5 of them had disappeared before 1915 and 1 before 1926.

TABLE 3

The final series: distribution according to year of birth and in 5-year periods.

Years	No. of prematures	No. of controls
1902—1906.....	183	188
1907—1911.....	253	253
1912—1916.....	322	321
1917—1921.....	241	240
Total.....	999	1 002

5 could not be identified with certainty.

These 16 cases were therefore excluded. Thus, the control series finally consisted of 1002 out of the 1018 children, *i.e.*, 98.43 per cent; they could be followed up from birth (1902—1921) until January 31st, 1948.

The distribution of the two series with regard to the number of births during each 5-year period between 1902 and 1921 is shown in Table 3.

2. Multiple Births

In order to compare the series of prematurely born children with those in earlier investigations and with the control series, the classifications described in the following were made.

In the majority of respects, the multiple births have been treated separately. This is because they imply special problems which distinguish them from other premature infants. This procedure has been adopted in only a few of the earlier investigations on the late prognosis for prematurely born children; it appears feasible in the present relatively large series.

According to my calculations, multiple births comprised 17.7 per cent of the original series of male prematures discharged alive from the maternity hospitals in question between 1902 and 1921. The incidence of multiple births among the premature infants born out of wedlock was 11.8 per cent, the corresponding figure for those born in wedlock being 23.6 per cent. In ANDERSON and LYONS' (1939) survey of the literature regarding the causes of prematurity, the incidence of multiple births among premature infants was stated to range between 6.3 per cent and 22.9 per cent. Multiple births are a more common occurrence in premature births in wedlock than out of wedlock.

The distribution of multiple births in the present series of premature infants is shown in Table 4.

TABLE 4
Plural-born children among the prematures.

Maternity hospital	No. of twins	Birth order		Pairs of twins
		Twin I	Twin II	
Pro P	23	11	12	4
ABBH.....	81	51	30	17 ¹
SBBH.....	136	70	66	25
Total	240	132	108	46 ¹

¹ Including 1 pair of triplets.

Thus, 146 single twins were included in the series of prematures; 15 of them had a twin brother in the control series and 32 had a twin who died at the maternity hospital. In the remaining cases, the twin was either a sister, or a twin brother with a birth weight outside the range of the present investigation.

In the control series, there were 21 twins; 2 of them had a twin in the same series, 15 had twin brothers in the series of prematures and 2 were single twins.

Four triplets were present in the series; they comprised those surviving out of the 3 triplet births in the series of prematures. There were no triplets in the control series.

3. Birth Weight

The number of premature infants with an extremely low birth weight is relatively small in the present series (Table 5). This could, however, be expected in view of the fact that it consisted of the children discharged alive from a

TABLE 5
Distribution of the children in the different birth weight groups:
prematures and controls.

Birth weight: grams	No. of children	Birth weight: grams	No. of children
1 010—1 250.....	5	2 760—3 000	141
1 260—1 500.....	16	3 010—3 250	213
1 510—1 750.....	59	3 260—3 500	306
1 760—2 000.....	116	3 510—3 750	342
2 010—2 250.....	300		
2 260—2 500.....	503		
Total	999	Total	1 002

TABLE 6

Distribution of the children according to birth weight and single or multiple birth.¹

Birth weight: grams	No. of prematures		No. of controls	
	Single-born 1.	Plural-born 2.	Single-born 3.	Plural-born 4.
1 010—2 000	121	75		
2 210—2 250	212	88		
2 260—2 500	426	77		
2 760—3 250			339	15
3 260—3 750			642	6
Total	759	240	981	21

maternity hospital during a period when the mortality among premature infants was extremely high. The series consisted only of children born in wedlock and only certain weight groups were included in the control series. For these reasons, the mean birth weight in the control series exceeded that originally stipulated, *i.e.*, 3250 grams, which was the figure given as the mean birth weight for male children during the period in question.

In the subsequent treatment of the material, the classification shown in Table 6¹ was that mainly used.

This combination was made in order to obtain larger groups for the statistical analyses.

The percentage of twin births among the premature infants was found to be greater the lower the birth weight group. It is seen from the table that the incidence in rising order of birth weight in the three groups was *38.3 per cent*, *29.3 per cent* and *15.3 per cent*, respectively.

4. Length at Birth¹

The length at birth was given in almost every case for those children born at ABBH and SBBH, but it was not noted in the records at Pro P. during the period in question. The length at birth and the mean length for single births and multiple births, respectively, in the different weight groups are recorded in Table 7.

¹ In the tables, the following denotations are used for the respective groups:

- 1 = single-born premature infants
- 2 = plural-born premature infants
- 3 = single-born controls
- 4 = plural-born controls.

TABLE 7

Length at birth in centimeters: prematures and controls.
 $(M \pm \varepsilon(M) = \text{Mean} \pm \text{standard error of the mean. } \sigma = \text{Standard deviation.})$

Birth weight: grams	Single-born children			Plural-born children		
	n	$M \pm \varepsilon(M)$	σ	n	$M \pm \varepsilon(M)$	σ
1 010—2 000	111	42.7 ± 0.21	2.2	71	42.5 ± 0.28	2.4
2 010—2 250	195	45.7 ± 0.13	1.8	75	45.5 ± 0.20	1.8
2 260—2 500	385	46.8 ± 0.08	1.6	70	45.9 ± 0.18	1.5
2 760—3 250	315	49.4 ± 0.09	1.6	14	48.3	
3 260—3 750	578	51.5 ± 0.06	1.5	4	50.3	

5. Degree of Prematurity

The number of days before or after calculated term at which the child was born was calculated in the same way for both series. The calculations were based on von Wachenfeldt's table (1926) and the time stated as the week during which the child was born in relationship to the last menstrual period. Exact data regarding the last menstrual period were, however, lacking in many of the cases. Only those cases were included in these calculations in which a date approximate to within a few days was given and when there was not too great a discrepancy between this date and the possible statement of the first observation of the foetal movements (Table 8).

TABLE 8

Number of days before calculated term at which birth took place:
 prematures and controls.
 $(M \pm \varepsilon(M) = \text{Mean} \pm \text{standard error of the mean. } \sigma = \text{Standard deviation.})$

Birth weight: grams	Single-born children			Plural-born children		
	n	$M \pm \varepsilon(M)$	σ	n	$M \pm \varepsilon(M)$	σ
1 010—2 000	107	43.3 ± 2.3	24.1	69	36.6 ± 2.2	17.9
2 010—2 250	183	28.5 ± 1.6	22.2	74	30.1 ± 2.4	20.9
2 260—2 500	367	22.8 ± 1.1	20.8	66	24.3 ± 2.4	19.8
2 760—3 250	296	8.1 ± 0.9	15.5		14.1	
3 260—3 750	549	2.2 ± 0.7	15.2		5.8	

6. Maternal Age

In series of premature infants, the maternal age usually differs from the average in that young, unmarried mothers are over-represented. On the other hand, it is often stated that mothers in the higher age groups are found to a greater extent than could be expected. In the present series, the children born out of wedlock were not included. The age of the mothers at the time of the delivery in question is shown in Table 9; a statement of the age was lacking in two cases.

TABLE 9

Mean age of the mothers at delivery: mothers of prematures and of controls. ($M \pm \varepsilon(M)$ = Mean $\pm$ standard error of the mean. σ = Standard deviation.)

Birth weight: grams	Single-born children			Plural-born children		
	<i>n</i>	$M \pm \varepsilon(M)$	σ	<i>n</i>	$M \pm \varepsilon(M)$	σ
1 010—2 000.....	121	29.1 ± 0.5	5.9	75	30.6 ± 0.7	6.4
2 010—2 250.....	212	28.9 ± 0.4	5.9	88	30.0 ± 0.6	5.2
2 260—2 500.....	426	28.7 ± 0.4	5.7	77	30.6 ± 0.6	5.6
2 760—3 250.....	339	28.8 ± 0.3	6.0	15	29.6	
3 260—3 750.....	640	28.7 ± 0.2	5.3	6	28.7	

The difference between the mean age of the mothers in the whole series of single premature births and that in the series of multiple premature births is 1.6 ± 0.43 per cent and is thus statistically significant. In the series of prematures and the control series, respectively, 59.5 ± 1.8 per cent and 59.4 ± 1.8 per cent, respectively, of the mothers of the single-born infants were below 30 years of age, whereas the corresponding figure for the premature multiple births is only 48.8 ± 3.2 per cent. In the present series, many of the older mothers gave birth to plural-born infants. This is in agreement with the established fact that the incidence of twin births increases with a rise in the maternal age. In the present series, no relationship was found between the mean maternal age and the birth weight of the single-born infants.

According to the Statistical Year Book of Sweden the mean age for the married parturient women in the whole country was 31.52 years in 1901—1910 and 31.23 years in 1911—1920.

7. Earlier Pregnancies

Information could also be obtained from the obstetric records regarding whether any earlier pregnancy had been terminated by spontaneous or induced abortion. The statements may be considered as fairly reliable, since

TABLE 10

Earlier abnormal terminations of pregnancy in multiparae:
mothers of prematures and of controls.

Birth weight: grams (current pregnancy)	No. of multiparae	No. of earlier		Percentage of abnormal terminations
		Abortions	Stillbirths	
Single births				
1 010—2 000.....	72	18	8	36.1
2 010—2 250.....	131	37	5	32.1
2 260—2 500.....	243	39	8	19.3
2 760—3 250.....	189	24	6	15.9
3 260—3 750.....	433	54	8	14.3
Multiple births				
1 010—2 000.....	50	6	1	14.0
2 010—2 250.....	56	7	3	17.7
2 260—2 500.....	55	5	2	12.7

the patients were married women and therefore had less reason to deny such an incident than unmarried women. The series of married mothers with full-term infants had also been questioned on this matter; in my opinion this fact permits fairly definite conclusions to be drawn. It is, however, possible that more detailed inquiries were made of the women admitted for delivery before expected term than of those in the control series. The information regarding earlier premature births was somewhat uncertain, since no heading for such statements was provided in the records. Moreover, the current norms for prematurity still varied appreciably. I did not, therefore, consider a statistical analysis of these data to be warranted. It may also be mentioned that Clason (1932) demonstrated that certain women exhibit a tendency to give birth consistently to underweight or overweight babies, respectively.

Table 10 shows the incidence of earlier abnormal terminations of pregnancy in the multiparae in the series, in cases of single births and multiple births, respectively. In the latter case, the inclusion in some cases of both twins of one mother must be taken into account as a possible source of error.

Altogether 14.9 per cent of the mothers of the premature plural-born children had earlier had abortions or stillborn infants, as compared to 14.8 per cent in the control series as a whole and 25.8 per cent of the mothers of the premature single-born infants. Moreover, in the last-mentioned category, the number of earlier abnormal terminations of pregnancy appeared to be greater the lower the birth weight of the infant in the current pregnancy.

If, however, the number of earlier pregnancies was used as the norm for the multiparae in both series, the conditions were the following. In the mothers of the premature single-born infants, 115 out of 1130 earlier pregnancies, *i.e.*, 10.2 ± 0.9 per cent, had terminated in abortion or stillbirth. The corresponding figure for the mothers of single-born infants in the control series was 92 out of 1389 pregnancies, *i.e.*, 6.6 ± 0.7 per cent, and for the mothers of premature plural-born children 24 out of 454, *i.e.*, 5.3 ± 1.1 per cent.

The difference between the respective categories in the series of prematurely born infants is 4.9 ± 1.4 per cent and between the mothers of single-born children in the two series 3.6 ± 1.1 per cent; thus both differences are statistically significant.

8. Parity Number

The parity number of the current pregnancy also plays some role. It is usually stated either according to obstetric standards as the number of pregnancies started, or according to mainly paediatric standards as the ordinal number of the children actually born. In the following, it is given as the ordinal number of the liveborn children, since abortions and stillbirths were dealt with in the preceding section. The corresponding figure for the number of pregnancies started is given in brackets.

In 44.3 ± 1.8 per cent (41.2 per cent) of the single births in the series of prematures, the child was the first child. The corresponding figure for the single births in the control series is 37.9 ± 1.5 per cent (36.3 per cent) and for the multiple births in the series of prematures 33.8 ± 3.0 per cent (32.9 per cent). According to the official statistics for maternity hospitals in Sweden (*cit.* from Thorén) the incidence of primiparae was 42.1 per cent in 1915 and 45.1 per cent in 1920. The difference between the incidence of first parities in the single births and multiple births in the series of prematurely born children is statistically significant, whereas the difference in this respect between the single births in the two series is probable. The respective figures are 10.5 ± 3.5 per cent and 6.4 ± 2.3 per cent.

Of the premature single-born children, 16.2 per cent had a birth parity among the liveborn children higher than three, the corresponding figure for the single-born children in the control series being 17.5 per cent and for the premature plural-born children 25.8 per cent. The difference between the two categories of prematures is 9.6 ± 3.3 per cent and is thus almost statistically significant. The higher birth-order number of the plural-born children is presumably associated with the established fact that the tendency to multiple births is more pronounced in older mothers.

9. Social Groups

The social group to which the father was assigned was based on the statement of his occupation made by the mother on admission to the maternity hospital. In some cases this was corrected from the notation in the baptismal register, which is taken from the extract from the parish register.

A classification was made into three social groups, according to the standards used in Sweden since 1911 in the official election statistics for the election of members of the Riksdag. To group I belong, for example, higher officials, directors of various kinds, and those with academic degrees or corresponding professional qualifications. Group II comprises such occupations as workshop foremen, office workers, non-commissioned officers or other positions requiring special but not academic qualifications and proprietors of small factories, or craftsmen, and farmers on a moderately large scale. To group III are referred employees in industrial work, trades or agriculture and those with lower positions in occupations requiring little or no specialized training.

TABLE 11
Social group of father.

Social group	No. of prematures 1 + 2.	No. of controls 3 + 4.
I	45	45
II	278	259
III	675	695
Unknown	1	3
Total	999	1 002

TABLE 12
Percentage distribution of the children in the respective
social groups of the father.

Social group	Percentage of prematures		Percentage of controls	
	Single-born	Plural-born	Single-born	Plural-born
I	4.1	5.8	4.5	5
II	27.8	27.9	26.2	14
III	68.1	66.3	69.3	81
Total	100.0	100.0	100.0	100.0

The main difficulties encountered in such a classification were in the borderline cases and for certain manual workers when the same denotation is used for the proprietor and for his employees. However, in both cases the probabilities of faulty classifications apply equally to both series.

The classification of the present series into the three aforementioned social groups according to the occupation of the father is recorded in Table 11.

The percentage distribution of the social groups with a division of the children into single births and multiple births is shown in Table 12.

10. Health of the Mother during Pregnancy

In all the hospital records, a special heading was devoted to the condition of the mother during the current pregnancy. Information on this matter was, however, lacking in *26.1 per cent* of the premature single-born infants, in *28.3 per cent* of the premature plural-born infants and in *31.5 per cent* of the single-born infants in the control series. The relatively low incidence of missing statements for the mothers of both the premature single-born infants and, to some extent, for those of the premature plural-born infants indicates that a more detailed history was taken in cases of prematurity. The difference between the two categories of mothers with premature infants also leads one to suspect that, in many cases, multiple birth was accepted as the cause of prematurity.

In *35.3 per cent*, *21.7 per cent* and *41.4 per cent*, respectively, of the cases in the aforementioned categories the mother was stated to have been healthy during the current pregnancy. Presumably, inquiries regarding the state of health were always made when taking the history. It is therefore highly probable that any more severe illness would have been recorded. It thus appears possible to assume that when statements concerning the condition during pregnancy were lacking, the mother was healthy. On this basis, the incidence of healthy or presumably healthy mothers was *61.4 per cent* for the premature single-born infants, *50.0 per cent* for the premature plural-born infants and *72.9 per cent* for the single-born controls.

Table 13 shows the distribution according to the diagnosis of those mothers who had suffered from some illness or disability during pregnancy, or who had exhibited symptoms of some such nature on admission to hospital. For practical reasons, several conditions have been combined in the table.

A calculation was made with the exclusion of the mothers with proteinuria of less than 0.1 per cent (determined according to Esbach) and of those with molimina or debility. The figures for true pathological conditions during pregnancy in the three groups (the 21 multiple births in the control series are not included in the table) were then as follows. For the premature single

TABLE 13

State of health of the mother during the current pregnancy.

Diagnosis	No. of mothers of single-born prematures 1.	No. of mothers of plural-born prematures 2.	No. of mothers of single-born controls 3.
Total No.	759	240	981
Debility, severe molimina	15	9	15
Trauma, overwork	2	1	1
Myoma, uterine prolapse	7	1	3
Early haemorrhage	14	2	7
Late haemorrhage	11	1	2
Proteinuria up to 0.1 % (Esbach)...	102	50	146
» 0.1—0.2 % » ...	29	12	23
Eclampsia, pre-eclampsia	37	13	14
Syphilis	3	3	3
Various forms of tuberculosis	12	3	8
Urinary tract infections	12	1	7
Respiratory tract infections	13	2	8
Other more severe infections	9	11	9
Heart disease	15	3	6
Miscellaneous	13	8	14
Total	294	120	266
Percentage	38.7 ± 1.8	50.0 ± 3.2	27.1 ± 1.4
True pathological conditions: No. ...	177	61	105
Percentage	23.3 ± 1.5	25.4 ± 2.8	10.7 ± 1.0
Difference: 1—3: 12.6 ± 1.8 per cent			

births, 177 out of 759 (30.6 per cent); for the premature multiple births 61 out of 240 (25.4 per cent), in this category the mothers with two children being recorded twice; and for single births in the control series 105 out of 981 (10.7 per cent).

This analysis showed that the conditions were similar to those found in the majority of other series of prematurely born infants. Thus, abruption of the placenta or different degrees of placenta praevia are important causative factors of premature birth, especially in single pregnancies. Moreover, various forms of proteinuria are a frequent finding in the mothers of both single-born and plural-born premature infants. To these common causes of prematurity must be added chronic and acute infections and cardiac diseases in the mother.

11. Pathological Conditions Associated with Labour

The statements in the obstetric records of abnormalities associated with labour are summarized in Table 14. On practical grounds, certain fairly similar conditions have been recorded under the same heading.

When a pelvic deformity was present, this was usually the reason for inducing labour before term. The distribution in the present series is in agreement with the statements in the literature of an increased incidence of placental abnormalities and of atypical presentations in premature births. In the multiple births, however, the presentations noted in the table were due, to some extent, to the termination of labour with podalic version and extraction. In the present series, protracted labour denotes an interval of more than 24 hours between the onset of labour and birth of the child. The cases of intra-uterine foetal asphyxia have not been included here, but have been recorded together with asphyxia occurring post-natally.

TABLE 14
Complications associated with labour.

Complication	No. of prematures		No. of controls
	Single-born 1.	Plural-born 2.	Single-born 3.
Total No.	759	240	981
Pelvic deformity	6	0	1
Hydramnios	2	1	2
Premature rupture of membranes ...	8	0	2
Precipitate birth	18	1	5
Abruption or abnormal position of placenta	21	2	2
Lesions of placenta	3	0	0
Breech presentation	35	31	15
Foot presentation	17	34	2
Transverse presentation	3	1	1
Brow presentation	1	1	0
Prolonged labour	88	16	129
Umbilical cord round neck	17	2	17
More than one complication	17	4	3
Total	236	93	179
Percentage	31.1 ± 1.7	38.7 ± 3.1	18.2 ± 1.2
Difference: 1—3: 12.9 ± 2.1 per cent			
1—2: 7.6 ± 3.5 » »			

12. Obstetric Interventions during Labour

The obstetric interventions during labour are recorded in Table 15.

In this respect as well, the conditions are similar in the present series to those in other series of prematurely born infants. At the beginning of this century, induced labour before term was a relatively common procedure in, for example, cases of pelvic deformity caused by rickets. Podalic version and extraction was also a fairly common intervention in twin births. Forceps were applied more frequently to a large foetus than to a small one.

TABLE 15
Obstetric interventions during labour.

Intervention	No. of prematures		No. of controls
	Single-born 1.	Plural-born 2.	Single-born 3.
Total No.	759	240	981
Induced labour before term	16	2	1
Podalic version and extraction.....	16	21	4
Low forceps	9	11	23
Mid-plane forceps	12	6	19
Expression	2	0	4
Caesarean section	0	1	0
Total	55	41	51
Percentage	7.2 ± 0.9	17.1 ± 2.4	5.2 ± 0.7
Difference: 1—3: 2.0 ± 1.1 per cent			
1—2: 9.9 ± 2.6 » »			

13. Condition of the Infant

Once the child had been born, few notes regarding the condition were made in the records. It is therefore probable that only the more outstanding abnormalities were recorded. Table 16 shows the observations regarding the post-natal state of the child found in the records. Severe asphyxia is not included in this table but is accounted for separately in Table 17.

It must be borne in mind that the infants concerned were those discharged alive from a maternity hospital.

As more severe asphyxia before the end of labour are denoted those cases in which the record noted slow foetal movements for some time, or a high meconium content in the liquor amnii. Also recorded in the table are those cases in which there was a note of a more severe cyanotic attack post-natally. Only those cases are included under the heading of foetal asphyxia in which this was the only symptom.

TABLE 16
Abnormalities in the children at birth.

Abnormality	No. of prematures		No. of controls
	Single-born 1.	Plural-born 2.	Single-born 3.
Total No.	759	240	981
Malformations	11	2	4
Probable birth injuries	10	0	1
Haemorrhagic disease	3	2	3
Sclerema neonatorum	5	3	1
Corneal opacities	2	0	0
Total	31	7	9
Percentage	4.1 ± 0.7	2.9 ± 1.1	0.9 ± 0.3
Difference: 1—3: 3.2 ± 0.8 per cent 1—2: 1.2 ± 1.3 » »			

TABLE 17
Asphyxia during and after birth.

	No. of prematures		No. of controls
	Single-born 1.	Plural-born 2.	Single-born 3.
Total No.	759	240	981
Foetal asphyxia	21	5	24
Neonatal asphyxia	43	15	28
Total	64	20	52
Percentage	8.4 ± 1.0	8.3 ± 1.8	5.3 ± 0.7
Difference: 1—3: 3.1 ± 1.2 per cent			

14. Summary

I have stressed repeatedly in the account of the material that the present series are selected in that they comprise only male children born in wedlock and discharged alive from the maternity hospital. For these reasons, the series are directly comparable neither with earlier reported series of prematurely born children, nor with corresponding normal conditions for Sweden

TABLE 18

Survey of the obstetric and paediatric differences between the single-born prematures (1) and the single-born controls (3) and between the single-born prematures (1) and the plural-born prematures (2), respectively. The controls are used as the norm.

Characteristic	Single-born prematures (1) compared to single-born controls (3)	Single-born prematures (1) compared to plural-born prematures (2)
Length at birth.....	1 shorter than 3	1 equal to 2
Birth before calc.term	1 earlier than 3	1 equal to 2
Mean age of mother.....	1 equal to 3	1 younger than 2
Earlier abortion or stillbirth....	1 more common than 3	1 more common than 2
First parity	1 more often than 3	1 more often than 2
Higher than 3rd parity	1 equal to 3	1 more seldom than 2
Social group of father	1 equal to 3	1 lower than 2
State of health of mother	1 poorer than 3	1 equal to 2
Complications during labour....	1 more common than 3	1 more seldom than 2
Intervention during labour	1 more common than 3	1 more seldom than 2
Abnormality in child	1 more common than 3	1 more common than 2
Asphyxia in child	1 more common than 3	1 equal to 2

during the period in question. The two series are, however, mutually comparable. I have therefore made a comparison in tabular form between these two series (Table 18). The conditions applying to the single-born children in the control series were used as the norm. The middle column in the table comprises a comparison between the control series and the single-born infants in the series of prematures. The last column records a comparison between the single-born premature infants and the plural-born premature infants.

CHAPTER V

Mortality

1. Total and Percentage Mortality and Mortality Risks

An account has already been given of the way in which the subjects in the series were traced, after discharge from the maternity hospital, through the census records and the parish registers. The follow-up investigation covered the events up to January 1st, 1948. It was possible to ascertain the date and, in practically every case, the cause of death of those who had died before this date.

"Congenital debility" was often given as the only cause of death in prematurely born infants who died within the first few months of discharge from hospital. Actually, the death of the majority of such infants who were healthy on leaving hospital was probably caused by infectious diseases, nutritional disturbances or other illnesses. Post-mortem examination was seldom made of such infants.

In the few cases in which the exact cause of death was not stated, the children had died at the beginning of the century in small country parishes. A diagnosis by a physician was not at that time an absolute requirement, but the clergyman of the parish could make a note of the probable cause of death and the certificate was then signed by a physician before forwarding it to the Central Bureau of Statistics.

With regard to children more than a few months old, the diagnosis of the cause of death may be considered as fairly reliable. Whenever possible in the survey in Table 19, only one diagnosis has been recorded, *i. e.*, the illness given in the death certificate as the main cause of death. In the subsequent analyses, these diagnoses were assembled into a number of main groups. It is principally in the case of the main groups comprising convulsive diseases and heart diseases that the earlier conceptions and those of today differ essentially. Under the heading of convulsive diseases were such divergent conditions as spasmophilia, encephalitis, and sequelae of cerebral haemorrhages. When heart disease was given as the cause of death, it was seldom stated whether the disease was congenital or acquired.

It may be considered that little of practical value is gained by a study of the mortality during the first years of life among children born so long ago. During these years, they lived under social and medical conditions that no

TABLE 19

Number of deaths in the series during the whole observation period:
distribution according to the cause.

Cause of death	Prematures		Controls	
	Single-born 1.	Plural-born 2.	Single-born 3.	Plural-born 4.
Unknown	1	1	2	—
Congenital debility	49	27	2	—
Various forms of tuberculosis...	26	6	39	—
Congenital syphilis	3	—	—	—
Resp. tract infections.....	45	27	31	—
Gastro-enteritis	17	8	10	—
Pertussis	7	5	3	—
Measles	7	1	1	—
Diphtheria	3	2	6	—
Scarlatina	5	1	7	—
Poliomyelitis	3	—	3	—
Other acute infections	12	5	7	1
Nephritis	3	—	4	—
Convulsive diseases.....	5	3	5	1
Intracranial haemorrhage, Litt- le's disease.....	3	1	—	—
Pylorospasm	2	—	1	—
Cong. or acq. heart disease....	9	3	9	—
Accidents, murder.....	12	4	11	—
Suicide.....	2	—	—	1
Malformations	1	—	1	—
Miscellaneous	6	1	11	1
More than one cause	4	—	1	—
Total	225	94	154	4

longer exist in Sweden, with its far advanced social equality, good provisions for the care of sick children and widespread prophylactic child welfare. As a result, the infant mortality rate in Sweden is the lowest in the world. It would therefore seem appropriate to look forward, rather than to dwell on matters that belong more to the historical aspects of medicine.

It must, however, be recalled that we are dealing with those age groups who are at present engaged in industrial production and who are of utmost importance for the smooth functioning of the community. Those factors which have resulted in the present structure of these age groups cannot be considered as lacking in topical interest. Moreover, the mortality among

TABLE 20

Mortality and percentage mortality from all causes and from acute infectious diseases: prematures and controls.

	Prematures		Controls Single-born 3.
	Single-born 1.	Plural-born 2.	
Total No.	759	240	981
Total mortality	225	94	154
Percentage	29.6 ± 1.7	39.2 ± 3.2	15.7 ± 1.2
Mortality from acute infect. diseases	99	49	68
Percentage	13.0 ± 1.2	20.4 ± 2.6	7.0 ± 0.8
Differences in total mortality: 1—3: 13.9 ± 2.1 per cent			
1—2: 9.6 ± 3.6 » » »			
Differences in mortality from 1—3: 6.0 ± 1.5 » »			
acute infectious diseases: 1—2: 7.4 ± 2.9 » »			

premature infants in Sweden has not declined to the same extent as that among full-term infants. The mortality among prematures is at present responsible for somewhat more than half of the total infant mortality (WALLGREN 1941, GYLLENSWÄRD 1946). Thus, 20—25 per cent of the premature infants in Sweden still die during their first year of life (ALM 1948). It is easier to ascertain the extent to which prematurely born infants are handicapped as compared to full-term infants by a study of those exposed to severe stresses at a time when the therapeutic possibilities were considerably less than at the present day.

Many of the children in my series were born or grew up during World War I which, even in Sweden, implied nutritional privation. They did not have the benefit of prophylaxis against rickets in the modern sense and they were exposed to the influenza pandemic of 1917—1918. Investigations of the mortality among prematurely born children during these years have been made by other workers but, as a rule, the follow-up period was short and the percentage that could be traced was relatively small. Moreover, no comparisons were made with control series comparable from the social and economic point of view.

The total mortality in the respective series in the present investigation up to January 1st, 1948 is shown in Table 19. As already mentioned, this does not include the deaths at the maternity hospitals.

It may be inferred from Table 20 that there is a statistically significant difference between the total mortality among the single-born prematures

TABLE 21

Total mortality: percentage distribution by different causes
(prematures and controls).

Cause of death	Prematures		Controls Single-born 3.
	Single-born 1.	Plural-born 2.	
Congenital debility	21.8	28.9	1.3
Various forms of tuberculosis.....	11.6	6.4	25.3
Resp. tract infections.....	20.0	28.7	20.1
Gastro-enteritis	7.6	8.5	6.5
Other acute infections	6.7	5.3	4.5
Pertussis, measles	6.2	6.4	2.6
Diphtheria, scarlatina	3.6	3.2	8.4
Convulsive diseases	3.6	4.3	3.2
Heart disease	4.0	3.2	5.8
Miscellaneous	14.9	5.1	22.3
Total	100.0	100.0	100.0

and the single-born controls. The difference in this respect between the two series of prematures is statistically probable. Infectious diseases appear to be responsible for a considerably larger number of deaths among the prematurely born children than among the controls. Moreover, as stated earlier, it is probable that a large proportion of the cases in which congenital debility was stated to be the only cause of death should also be referred to this group. In Table 20, however, only those cases have been included in which an acute infectious disease was stated to be the main cause of death. In this case as well, there is a statistically probable difference between the single-born and the plural-born premature children and a statistically significant difference between the single-born prematures and the single-born controls.

Table 21 shows the distribution of the main causes of death calculated on the total mortality in each series.

A striking feature in all these tables is the high mortality among the premature plural-born children, which is not found in present statistics from the same maternity hospitals. This excess mortality is present mainly in the group of acute infectious diseases.

A relatively large number of the deaths in the control series were caused by tuberculosis. A survey of the incidence and mortality of tuberculosis will be given in a later chapter (pp. 77—79).

The lower the birth weight of prematurely born children, the greater is the mortality risk. The mortality in the various weight groups in the respective

TABLE 22

Percentage mortality in the different birth weight groups:
prematures and controls.

Birth weight: grams	Single births		Multiple births	
	No.	Deaths in per cent	No.	Deaths in per cent
1 010—2 000.....	121	27.3 ± 4.1	75	34.6 ± 5.5
2 010—2 250.....	212	15.6 ± 2.5	88	23.9 ± 4.5
2 260—2 500.....	426	13.4 ± 1.7	77	22.1 ± 4.7
2 760—3 250.....	339	6.8 ± 1.4		
3 260—3 750.....	642	4.0 ± 0.8		

series is recorded in Table 22, in which only the deaths during the first year of life are taken into account.

Even though the figures in Table 22 refer only to the mortality up to one year of age, the conditions are similar up to five years of age. The mortality rate was found to fall with a rising birth weight and the relative mortality rate among the premature plural-born children was consistently higher, showing no tendency to fall in relationship to that of the premature single-born children. On the other hand, a calculation of the mortality after the age of five years until the end of the observation period gave the following figures: for the 591 premature single-born children 10.1 ± 1.2 per cent, for the 153 premature plural-born children 5.2 ± 1.8 per cent and for the 889 single-born controls 7.1 ± 0.9 per cent. The difference between the premature single-born children and the premature plural-born children is 4.9 ± 2.2 per cent and between the single-born prematures and the single-born controls 3.0 ± 1.5 per cent. Thus, the difference is significant in neither case.

It has been stressed repeatedly in the literature that social and economic factors influence infant mortality and that of premature infants in particular. I therefore calculated the mortality rate in the present series with a classification according to the social group to which the father belonged. Only the mortality during the first two years of life was included, since the difference in this respect between the series was still large at this age (Table 23).

It may be inferred from the table that the differences between all three series are statistically significant in social group III; this also applies to the difference between the single-born prematures and the single-born controls in social group II. The mortality was consistently highest among the premature plural-born children.

It has long been an established fact that the mother's state of health during pregnancy greatly influences the condition of her child at birth. Its

TABLE 23

Percentage mortality during the first two years of life:
classification according to the social group of the father.

Social group	Prematures				Controls	
	Single-born 1.		Plural-born 2.		Single-born 3.	
	No.	Deaths in per cent	No.	Deaths in per cent	No.	Deaths in per cent
I.	31	3.2 ± 3.2	14	7.1 ± 6.9	44	—
II.	211	18.5 ± 2.7	67	26.7 ± 5.4	256	7.0 ± 1.6
III.	516	22.6 ± 1.8	159	40.1 ± 3.9	678	9.4 ± 1.1
Differences: II. 1—3: 11.5 ± 3.1 per cent						
II. 1—2: 8.2 ± 6.0 » »						
III. 1—3: 13.2 ± 2.2 » »						
III. 1—2: 17.5 ± 4.3 » »						

effect on neonatal mortality is particularly marked, but this mortality is not included in the present investigation. The effect may, however, be of longer duration. I therefore calculated the mortality rate during the first year of life, after discharge from the maternity hospital, in relationship to the existing information about the state of health of the mother (Table 24)

TABLE 24

Mortality during the first year of life: classification according to the state of health of the mother during pregnancy.

State of health of mother	Prematures				Controls	
	Single-born 1.		Plural-born 2.		Single-born 3.	
	No.	Deaths in per cent	No.	Deaths in per cent	No.	Deaths in per cent
Presumably healthy I	465	1.6 ± 0.6	120	3.1 ± 1.6	715	0.5 ± 0.3
Slight ill-health II	117	10.3 ± 2.8	59	15.3 ± 4.7	161	4.3 ± 1.6
Illness III	177	20.9 ± 3.1	61	29.5 ± 5.8	105	8.6 ± 2.7
Differences: I—II		8.7 ± 2.9		12.2 ± 5.0		3.8 ± 1.6
I—III		19.3 ± 3.1		26.4 ± 6.1		8.1 ± 2.8

— *cf.* Chap. IV, Obstetric and Paediatric Account. In this table as well, the fact that mothers of the plural-born children are included more than once must be taken into consideration as a source of error.

The conditions disclosed by the table are those that could be expected, *i.e.*, the mortality was higher among the children of mothers with more severe

TABLE 25

Percentage mortality during the first year of life: classification according to birth weight (prematures and controls).

Birth weight: grams		Months of life		
		0—2	2—12	0—12
<i>Single births</i>				
1 010—2 250.....	No.	333	286	333
	Deaths in per cent	14.4±1.9	6.6±1.5	19.8±2.2
2 260—2 500.....	No.	426	395	426
	Deaths in per cent	7.3±1.3	6.6±1.3	13.4±1.7
2 760—3 250.....	No.	339	327	339
	Deaths in per cent	3.5±1.0	3.4±1.0	6.8±1.7
3 260—3 750.....	No.	642	634	642
	Deaths in per cent	1.2±0.4	2.8±0.7	4.0±0.8
<i>Multiple births</i>				
1 010—2 250.....	No.	163	131	163
	Deaths in per cent	19.6±3.1	11.5±2.8	28.8±3.6
2 260—2 500.....	No.	77	68	77
	Deaths in per cent	11.7±3.7	11.8±3.9	22.1±4.7

illnesses. The remarkable feature is that the differences were so considerable even after discharge from the maternity hospital. Here again, the mortality was highest among the premature plural-born children. The difference between the mortality among the children of presumably healthy mothers and among those of mothers with some severe illness is statistically significant in both the series of single-born and of plural-born premature infants and almost statistically significant for the single-born children in the control series. The difference between the mortality rate for children of healthy mothers and for those of mothers suffering from slight ill-health is significant in the single-born prematures only.

It is evident from Tables 19—24 that the mortality rate was higher among prematurely born than among full-term infants. The question then arises of when the differences become evened out. In order to obtain information on this matter, I calculated the mortality among the premature single-born, premature plural-born and full-term single-born infants, respectively, during the first year of life (Table 25). I wished to take the birth weight factor into account but also to obtain as large as possible a number in each group. The

TABLE 26

Mortality risks in the respective series.

Age: years	Prematures						Controls Single-born 3.		
	Single-born 1.			Plural-born 2.					
	Years of observa- tion	Deaths		Years of observa- tion	Deaths		Years of observa- tion	Deaths	
		No.	Per cent		No.	Per cent		No.	Per cent
0— 1.....	759	123	16.2	240	64	26.7	981	49	5.0
1— 2.....	636	22	3.5	176	15	8.5	932	18	1.9
2— 3.....	612	10	1.6	161	5	3.1	914	16	1.8
3— 4.....	601	4	0.7	156	1	0.6	897	4	0.4
4— 5.....	595	3	0.5	155	2	1.3	893	4	0.4
0— 5.....	3 203	162	5.1	888	87	9.8	4 617	91	2.0
5—10.....	2 921	19	0.7	751	4	0.5	4 423	12	0.3
10—15.....	2 827	5	0.2	743	1	0.1	4 361	5	0.1
15—20.....	2 790	11	0.4	736	2	0.3	4 310	16	0.4
20—25.....	2 727	9	0.3	730	1	0.1	4 217	13	0.3
25—30.....	2 473	7	0.3	656	—	—	3 834	7	0.2
30—35.....	1 707	6	0.4	441	—	—	2 635	4	0.2
35—40.....	888	2	0.2	204	—	—	1 388	4	0.3
40—45.....	294	1	0.3	77	—	—	461	2	0.4

premature infants were therefore divided into two groups only, *i.e.*, those with a birth weight above and below 2250 grams, respectively.

The greatest difference between the respective groups was found during the first two months of life; during the subsequent 10 months, there were no differences between the weight groups in each series separately. In a comparison between the weight groups in the different series, a difference is, however, apparent.

The mortality risks both for each of the first five years of life and thereafter for the whole observation period in 5-year periods are shown in Table 26.

The mortality risk is highest and the differences between the series greatest during the first two to three years of life. During each 5-year period after five years of age, no difference was found in the mortality in the respective series. If, however, all the deaths after five years of age are added together, a tendency is found to a higher mortality among the premature single-born infants, the lowest figure being found for the premature plural-born infants (see p. 62).

The present series derive from a period during which relatively few therapeutic aids were available and large families were common. I therefore tried

TABLE 27

Percentage mortality up to two years of age in children with and without older siblings; prematures and controls.

Birth order no.	Prematures				Controls	
	Single-born 1.		Plural-born 2.		Single-born 3.	
	No.	Deaths in per cent	No.	Deaths in per cent	No.	Deaths in per cent
I	336	16.1 $\pm$ 2.0	81	29.6 $\pm$ 5.1	372	5.9 $\pm$ 1.2
II	201	21.4 $\pm$ 2.9	67	32.8 $\pm$ 5.7	291	6.5 $\pm$ 1.4
III	98	21.4 $\pm$ 4.1	30	36.7 $\pm$ 8.8	146	9.6 $\pm$ 2.5
>III	123	29.3 $\pm$ 4.1	62	43.5 $\pm$ 6.3	172	16.2 $\pm$ 2.8
Difference: I—>III		13.2 $\pm$ 4.6		13.9 $\pm$ 8.1		10.3 $\pm$ 1.7

to ascertain whether any difference was present in the mortality rate for the first child and for the children with a higher birth order number. I considered that the principal factor that might be expected to increase the mortality rate for the latter category was the risk of infection by older siblings. The mortality rate for children with and without older siblings, respectively, is shown in Table 27.

The difference in the mortality rate for the first child and for the children with more than three older surviving siblings is statistically significant for the single-born children in the control series. Since there is also a tendency to a rise in the mortality rate with an increasing number of siblings in the series of prematures as well, it is probable that the differences would have been statistically significant in a larger series. It may be mentioned that I had no information regarding the length of time for which older siblings had survived.

I also analyzed the incidence of deaths during the first months of life for those born during the various months and seasons of the year. No facts were forthcoming that permitted any conclusions to be drawn from the present series. I was unable to find any seasonal variations in the mortality rate, although the observation period covered 20 years. I did not, however, take the neonatal mortality into consideration.

A study of the causes of death at different ages yielded little information other than that reported by other workers, or confirmation of long established facts. Only a brief summary is therefore given.

The diagnosis "congenital debility" which, as already mentioned, certainly masked a number of conditions of varying nature, was almost exclusively used for children who died during the first two months of life. The children

who died of tuberculosis during their first year of life were mainly those with a mother suffering from this disease. The peaks in the mortality from tuberculosis that have often been shown to occur during the first years of life, during adolescence and in the twenties could also be discerned in the present series.

There were somewhat more deaths from measles and pertussis among both the premature single-born and plural-born children than among the controls. No such difference was found for the mortality from scarlatina or diphtheria.

An account of the mortality in children in Sweden less than five years of age from 1911 to 1945 has been given by STRÖM (1948). He gave the figures for the mortality from various infectious diseases, both for infants and for children of 1—5 years of age. In children born between 1911 and 1925, pertussis was the most common fatal disease of the infectious diseases of childhood. This applied in particular to the first of life, but the mortality was also high during the subsequent four years of life. Up to 1915, similar conditions, although less marked, were found for measles. During these years, there were many deaths from scarlatina, and still more from diphtheria, particularly from 1—5 years of age.

This difference in the age distribution was also apparent in the present series. Thus, scarcely any deaths were caused by diphtheria and scarlatina during the first year of life, whereas more than half the deaths were accounted for by pertussis and measles. The incidence of deaths from measles and pertussis was higher for the prematurely born infants than for the controls during the first year of life, whereas the figures for the mortality from scarlatina and diphtheria were almost the same at a slightly higher age. This confirms the general view that the resistance of prematurely born children to infections increases with rising age.

In the present series, the incidence of deaths due to other infectious diseases was considerably higher for the prematurely born children, particularly during their first year of life. The difference between them and the controls in this respect was exceedingly small after five years of age.

The only widespread epidemic in Sweden during the present century was the pandemic influenza during the last years of World War I. A study of the mortality in the present series during 1916 to 1920 showed an increase in the deaths from certain infectious diseases during 1917 to 1919, a fact that may be attributed to this epidemic. An increasing number of death certificates then gave such diagnoses as epidemic influenza, capillary bronchitis, pneumonia and acute bronchopneumonia.

As stated earlier, the diagnosis of a respiratory tract infection could be considered as reliable only in children over two months of age. For this reason, I confined the calculation to children above this age. This procedure

presumably resulted in too low a figure for the mortality among the prematures, since the two months during which their susceptibility to infection is greatest were excluded. I did not calculate the number in the series at this stage, nor did I divide the prematures into single-born and plural-born children. The relative size of the series may be calculated on the basis of the fact that there were 880 prematurely born children and 961 controls, these being the numbers of those in the final series that survived the age of two months.

Between 1917 and 1919, 20 prematures (single-born and plural-born collectively) died of the aforementioned illnesses after the age of two months, as compared to only 2 of the controls. There is thus a considerable excess mortality among the prematurely born children if, on the basis of the aforementioned figures, calculations are made of the expected mortality in the other series. This also applies in a calculation of the mortality risks on the basis of the existing relationship between the actual number of deaths from infectious diseases (but not from so-called epidemic diseases of childhood) after the age of two months in the final series. The figures are then 87 for the prematures (single births and multiple births collectively) and 41 for the controls.

2. Discussion

The opinions in the literature are at variance with regard to the mortality risks for single-born and plural-born premature infants, respectively. For example, DUNHAM and MCALENNEY (1936) and PECKHAM (1939) concluded on the basis of their investigations that premature twins have a better chance of survival than single-born premature infants. They based their opinion on the assumption that the former infants are relatively more mature than their birth weight indicates. DUFFIELD *et al.* (1939) stressed, on the contrary, that the mortality rate is higher among plural-born than among single-born prematures. They considered this to depend on the higher incidence of extremely low birth weights in multiple births.

In the present series of prematurely born children, the total mortality risk is, with a high degree of probability, higher for the plural-born than for the single-born children (Table 20). According to Table 22, a larger number of the former category than the latter had a birth weight below 2000 grams, the respective figures being *31.3 per cent* and *15.9 per cent*. The mortality was consistently higher in each weight group for the premature plural-born children, the difference even showing a tendency to increase with a rise in the birth weight. Thus, the difference between the mortality for the plural-born and single-born prematures in the respective weight groups is *7.3 per cent*, *8.3 per cent* and *8.7 per cent*. Moreover, it is evident from Table 23

that the difference between the mortality in the two categories of prematurely born children is statistically significant in social group III, *i.e.*, the mortality is higher for the plural-born prematures.

The fact that the mortality rate in the present series was higher for the premature plural-born children than for the single-born prematures, contrary to the observations in other series of prematures, may be dependent on several factors. (I must once more stress that I am dealing only with the mortality after the infants were discharged from the maternity hospital.) My series is somewhat more uniform than earlier series, in that unmarried, often young mothers of poor social and economic status are not included. The mortality among the children of such mothers is often extremely high and they are more infrequently plural-born. In my original series of all those premature infants who were discharged alive from the maternity hospital, the incidence of multiple births among the children born out of wedlock was 11.8 per cent, as compared to 23.6 per cent among those born in wedlock. As stated earlier, the mothers of plural-born premature children in my series were mainly somewhat older multiparae. The initial social status of the plural-born children was possibly slightly better than that of the single-born children (Table 12). In other respects the series is uniform. The results of the investigation therefore contradict the statement that the chances of survival are greater for the plural-born premature infants than for the single-born prematures in comparable series. Two possible explanations of the difference in the mortality rate are the following. A large number of the single-born premature infants may have died at the maternity hospital. The plural-born children often had a higher birth order number, with a resulting greater risk of infection at home (*cf.* Table 27).

Many series of prematurely born children include all types of prematures with an over-representation of the aforementioned category of young mothers of poor social and economic status, who are usually delivered in a maternity hospital. In such cases, the respective figures for the mortality among single-born and plural-born children may differ essentially from those in the present series.

CHAPTER VI

Registration for Census

In the subsequent study of the prognosis, attempts were made to estimate the chances of the subjects being registered in one of the communal welfare registers of the City of Stockholm. It was therefore of interest to ascertain exactly how many of the subjects were registered for census purposes in Stockholm during each of the years during which these registers have existed or during the years covered by the investigation. Attempts were therefore made to follow the moves of the subjects in detail, a procedure which involved considerable difficulties.

No central census register for Stockholm existed before 1926. To obtain information regarding the moves before this date, it was therefore necessary to consult the different parish registers. For this reason, those who were domiciled in Stockholm in 1926 were not, as a rule, followed backwards in time from this date in order to ascertain the presumably small number who had moved from Stockholm and back to the city before this time. It was usually possible to obtain information about those who had definitely left Stockholm before 1926, by following them from one parish register to the next. It nevertheless proved impossible to carry out my original intentions, but the series were instead classified into the following five main groups:

- I. Those who were not known to have moved from Stockholm.
- II. Those who had presumably lived in Stockholm for more than two-thirds of the observation period.
- III. Those who had lived in some other place than Stockholm for between one-third and two-thirds of the observation period.
- IV. Those who had lived in some other place than Stockholm for more than two-thirds of the observation period.
- V. Those who had left Sweden.

These groups are recorded in tabular form in Table 28.

Subsequently, the sum of groups I and II was, as a rule, used as the comparative norm for estimating the differences in the series for those listed in the communal welfare registers of Stockholm. Unless otherwise stated, the sum of groups I to IV inclusively was used as a comparative norm for the registers covering the whole of Sweden. The differences between the respective series are, however, presumably due to a random distribution. An analysis of a small part of the material in order to follow the moves in detail showed

TABLE 28

Change of domicile (=move from Stockholm) among those surviving until January 1st, 1948.

Domicile group	Prematures				Controls Single-born 3.	
	Single-born 1.		Plural-born 2.			
	No.	Per cent	No.	Per cent	No.	Per cent
I	297	55.6	78	53.8	460	55.6
II	65	12.2	25	17.2	142	17.2
III	66	32.2	22	29.0	136	27.2
IV	88		19		75	
V	18		1		14	
Total	534	100.0	145	100.0	827	100.0
I + II	362	67.8	103	71.0	602	72.8
I—IV incl.	516	96.6	144	99.3	813	98.3

that, if greater Stockholm is regarded as a geographical and economic unit, no difference between the series is present.

After the first few years of life, little difference was found between the mortality in the series of prematurely born children and in that of the controls. No calculations of the risks were made for the different age groups, with the exception of for those listed in the Penal Register and in the Register of the Liquor Control Board. This was because these registers cover the whole of Sweden and the incidence could therefore be calculated without taking into consideration the moves from Stockholm.

Certain Pathological Conditions

1. Mental Subnormality: Special Classes in Stockholm

It was stated in the general principles for the present investigation that the observation period should be as long as possible, since no study has hitherto been made in which a series of prematurely born children has been followed up until adult age. The conditions during pre-school age in particular and those during school age have been investigated by a number of workers.

I had originally intended to include in the investigation the school-leaving certificate. This nevertheless proved impracticable for the years in question. The number of children finishing their schooling in Stockholm during each of the relevant years amounted to up to 10,000. The school-leaving certificates are filed in the archives but not in alphabetical order. It would have been an exceedingly time-consuming task and an expensive one to obtain the information required. I therefore investigated instead of the incidence of those who were unable to follow the instruction in the ordinary classes.

Special classes have been in existence in Stockholm since 1905. Since they have a central register, it was relatively easy to obtain information about those children who were assigned to such classes. According to RAMER (1946) — who made a follow-up study of special-class pupils in Stockholm, born between 1905 and 1917 — until 1919, children were recommended for transfer to special classes by the teachers and examined by the school doctors. After 1919, psychiatrists were appointed to supervise this transfer and the I.Q. was determined in each case.

Up to 1925, there were no special schools for educable mentally deficient children. It is therefore possible that, before this date, a number of such children attended the special classes. In 1920, so-called B classes were established as an intermediate stage between the ordinary classes and the special classes. According to Ramer, they initially contained a heterogeneous collection of moderately mentally defective children, children with poor sight, word-blind children and those physically unfit. For the sake of uniformity, only those children assigned to the special classes were included in the present calculations.

A factor which affected the transfer during the first years, and probably during the greater part of the period in question, is that only the most

TABLE 29

Subjects attending special classes in the City of Stockholm:
prematures and controls.

	Prematures		Controls Single-born 3.
	Single-born 1.	Plural-born 2.	
Incidence calculated on	362	103	602
No. attending special classes	12	6	10
Mean no. of yrs. of attendance.....	5.4	5.5	5.1
Percentage.....	3.3 ± 0.9	5.8 ± 2.3	1.7 ± 0.5
Differences: 1—3: 1.6 ± 1.1 per cent			
1—2: 2.5 ± 1.4 » »			

markedly mentally defective children and those who were a disturbing element were assigned to the special classes. Moreover, there was presumably some geographical selection, since only certain schools had such classes. Children attending other schools would have been less likely to be transferred to special classes since they would then have had a long way to go to school.

The distribution of the children in the present series who attended special classes is shown in Table 29. The incidence was calculated on the surviving children who had lived practically all their life in Stockholm and is therefore presumably slightly too high. The figures for the series of prematurely born children are probably affected to a somewhat greater extent, since the incidence of later moves from Stockholm must have been slightly higher in their case (see Table 28). At the time in question, schooling was compulsory from the year in which a child reached 7 years of age up to and including that in which he was 14 years old. The difference in the incidence of moves from Stockholm was certainly less at that time than at the end of the observation period, *i.e.*, at the turn of the year 1947—1948. All the children ended their schooling according to § 48 in the regulations for elementary schools. This implies that they finished their schooling because they were no longer of compulsory school age, but that they had not attained the skill or the knowledge required of children attending ordinary classes.

Table 29 does not include the ineducable mentally defective children and only some of the educable mentally defective children. The records only list those who attended special classes for some time or who were referred for examination. The differences are apparent, although not *statistically* probable, but it need scarcely be pointed out that this is presumably due to the

relatively small number of cases. The majority of authors who have dealt with prematurely born children of school age have reported an increased incidence of children with a low I.Q.

2. Institutional Care and Disability Pensions

During the investigations made in the parish registers in various parts of the country, in the census records and in the Social Welfare Register in Stockholm, the names were obtained of those who had been, or were still, in mental hospitals, institutions for the mentally deficient or other institutions. Diseases constituting an impediment to marriage are noted in the parish registers; this also applies to the census records. Those who are admitted to institutions and those who are permanently incapable of supporting themselves are listed in the records of the Social Welfare Register of the City of Stockholm and of the National Pensions Board. Since state subsidies are paid, it is in the interest of every commune to apply for pensions in such cases. Presumably, the financial situation of only a few of the subjects was such that their institutional care would not have been recorded in one or other of the registers concerned. The figures for such cases are given in Table 30.

It may be mentioned that a number of borderline cases between imbecility and mental disease are cared for in mental hospitals, but the majority of patients suffer from such conditions that can scarcely be considered, according

TABLE 30

Subjects hospitalized in various institutions: prematures and controls.

Type of institution	Prematures		Controls Single-born 3.
	Single-born 1.	Plural-born 2.	
Incidence calculated on	516	144	813
Mental hospitals.....	9	1	8
Inst. for mental defectives.....	9	1	1
Inst. for cripples	5	—	—
Inst. for blind.....	1	—	—
Other institutions.....	1	1	1
Total.....	25	3	10
Percentage	4.8 ± 0.9	2.1 ± 1.2	1.2 ± 0.4
Differences: 1—3: 3.6 ± 1.0 per cent			
1—2: 2.7 ± 1.5 » »			

to current conceptions, to be associated with premature birth. If those subjects treated at mental hospitals are excluded and the calculations are confined to those in other institutions, the following incidence figures are found. For single-born prematures 3.1 ± 0.8 per cent, for plural-born prematures 1.4 ± 1.0 per cent and for the single-born controls 0.25 ± 0.18 per cent. Thus, in this respect as well, the difference between the single-born prematures and the single-born controls (2.85 ± 0.78 per cent) is statistically significant, whereas the difference between the single-born prematures and the plural-born prematures (1.7 ± 1.2 per cent) is not significant. Only the number of subjects in the respective forms of institutions are recorded in Table 30. A more detailed account of those listed in the register of the National Pensions Board, together with the diagnoses, is given in the following section.

All those persons who have been granted pensions according to the Act of 1913 are listed in the register of the National Pensions Board. According to this Act, every Swedish citizen is entitled to a pension upon reaching 67 years of age or if, after the age of 16, he is unable to provide for his maintenance by gainful employment, owing to some form of disablement. The Act has subsequently been amended, but the basic principles are the same. In practice, a reduction of the normal capacity for work by two-thirds qualifies for a disablement pension. The absolute and percentage figures for the subjects in the present series granted disablement pensions are recorded in Table 31.

The same comment may be made to this table as to the preceding one, *i.e.*, it may be presumed that only in a few cases was the financial situation such that the subject did not apply for a disablement pension when his earning capacity was reduced to one-third of the normal. In those cases in which communal relief was necessary, the commune applied for a pension.

The main diseases that are considered to be associated with prematurity are various degrees of mental deficiency, epilepsy and spastic paralysis (Little's disease). It is only with regard to these diseases that a statistically significant difference is found between the single-born premature children and the single-born controls.

Opinions are now in agreement regarding the cause of the more common occurrence of these diseases among prematurely born children. They are due to cerebral accidents during birth, arising on the grounds of the fragility of the capillaries, and possibly to asphyxia. A survey is given in the following of the complications during birth in those children suffering from mental deficiency, spastic paralysis or epilepsy.

In the four such cases in the premature plural-born series and the six in the control series, no mention was made in the birth record of any complica-

7. Little's disease:	Foetal asphyxia.
8. do.	Breech presentation.
9. do.	Premature rupture of the membranes.

The majority of these complications during labour could give rise to, or be a result of, cerebral injury to the child.

3. Tuberculosis: Morbidity and Mortality

A tuberculosis register has existed for a long time in Stockholm; it developed out of one of the poor relief registers. Long illness of the family provider or of his wife naturally resulted in a need for assistance which was dependent partly on medical factors. The considerations therefore included not only a social and economic investigation, but also a medical investigation and medical control. These reports were incorporated into the tuberculosis register which was drawn up in connexion with the intensification of dispensary service about 1940.

From the beginning of this century until the middle of the nineteen-twenties, the diagnosis of tuberculosis was usually based on physical examinations and sputum tests. On the other hand, these cases were often kept under observation for many years and examinations made of other members of the family. After going through the family case-histories, these diagnoses could be denoted as possessing a fairly high degree of accuracy. They were substantiated by the later history of the other members of the family and the large number of children who became secondarily infected with tuberculosis.

When the use of radiography became increasingly widespread, the diagnosis could be made at an earlier stage and with considerable certainty. Since 1939, tuberculosis that may be presumed to be active is a notifiable disease. During the nineteen-forties, anti-tuberculosis work was particularly intense; the results have also been apparent in a sharply decreased incidence of tuberculosis.

The majority of the subjects in the present investigation underwent mass radiography during their military service. Cases of tuberculosis discovered in this way were reported to the dispensary in the place of residence. In addition, mass radiography has become increasingly common in factories and offices during recent years.

I have assembled in one group those subjects who were listed in the tuberculosis register of the City of Stockholm on the grounds that they had been summoned for examination on one or more occasions, owing to a case of tuberculosis in the family or environment. Those who were listed because

TABLE 32

Morbidity in tuberculosis for subjects resident in Stockholm and mortality from tuberculosis after one year of age in the whole country: prematures and controls.

	Prematures		Controls
	Single-born 1.	Plural-born 2.	Single-born 3.
Incidence calculated on	362	103	602
Mild tuberculosis	34	14	65
Severe tuberculosis	6	1	13
Total.....	40	15	78
Percentage	11.0 ± 1.7	14.6 ± 3.5	13.0 ± 1.4
Incidence calculated on	636	176	932
Deaths from tuberculosis after 1 yr. of age	23	5	35
Percentage	3.6 ± 0.7	2.8 ± 1.2	3.8 ± 0.6
Differences in morbidity: 1—3: 2.0 ± 2.1 per cent			
1—2: 3.6 ± 3.9 » »			
Differences in mortality: 1—3: 0.2 ± 1.0 » »			
1—2: 0.8 ± 1.5 » »			

they had earlier, or still had, tuberculosis of such a mild degree that they were kept under observation, but were not admitted to a sanatorium or hospital except for examination were referred to another group. Those who were hospitalized for some time and were given active therapy, even if the disease could be denoted as relatively mild, were assembled in another group together with more severe cases, who survived until January 1st, 1948. Frequency calculations were then made for these three groups, based on the number living during the whole observation period and who had spent their whole life, or the greater part of it, in Stockholm.

Those who, after the age of one year but before January 1st, 1948, died of a tuberculous disease somewhere in Sweden are accounted for separately.

The reason for which the mortality in Table 32 was calculated only for those who survived their first year of life is that tuberculosis in the mother has often been stated to be a common cause of premature birth. This applies even to series from fairly recent years. It was formerly fairly difficult to diagnose tuberculosis after only a short observation period and the attitude

towards the prognosis was somewhat fatalistic. It was therefore not uncommon for prematurely born infants to be sent home to the mother, despite a statement in the hospital record that she was suspected to suffer from tuberculosis, or even definitely suffered from it. I therefore assumed that the risks of contracting tuberculosis or of dying of it during the first year of life would be greatest for the single-born premature infants. If a comparison is made between Table 32 and Table 19, no such tendency seems to exist.

If an attempt is made to estimate the risks of infection in the respective series on the basis of the number of known environmental cases, of which the majority consist of tuberculosis in the family, the following figures are found. For the premature single-born children 59, *i.e.*, 16.3 *per cent*, for the premature plural-born children 18, *i.e.*, 17.4 *per cent* and for the single-born controls 91, *i.e.*, 15.1 *per cent*. The calculations are based on the number surviving on January 1st, 1948.

CHAPTER VIII

Characteristics Recorded in Military Registers

1. Introduction

Conscription in the modern meaning of the term has been in force in Sweden since 1872. In 1901 the length of service was prolonged and since then it has undergone some variations. As a rule, those concerned in the present investigation were liable to military service from their 20th to their 47th year inclusive.

On enrolment, the height, weight and chest measurements are recorded. A routine medical examination is made, including testing of the visual acuity and hearing. Any existing medical certificates are given to the medical officer; it is incumbent on him to take them into due consideration when deciding the fitness for service of the conscript. A conscript in possession of a satisfactory medical certificate stating that he is unfit, on physical or mental grounds, for military service is exempt from personal attendance at the enrolment centre.

The conscripts are referred on enrolment to one of the following fitness classifications, depending on the physical constitution and general state of health:

- a) Grades 1, 2, 3 and 4: fit for active service.
- b) Grade T: temporarily unfit for active service.
- c) Grade O: unfit for active service.

Conscripts with an extremely good physical constitution and qualities suitable for strenuous active service are referred to grade 1. To grade 2 are referred those who, on the basis of their physical constitution, bodily health and mental qualities, are considered fully fit for active service. Grade 3 comprises those who, owing to some defect, disability or illness, are only partially fit for active service. Grade 4 consists of those who, for the same reasons as in grade 3 but to a greater extent, are only of limited use for military purposes. Those in grade T are such cases in which the hindrance to military service is assumed to be of a temporary nature; they are re-examined at the age of 22 or later. Grade O implies that the conscript, owing to disability, chronic disease or permanent physical weakness, is unfit for active service.

All those in grade 4 and many of those in grade 3 are required to perform fatigue duties or clerical work but are exempted from bearing arms. The

medical sheet of those in grades 3, 4, T and O must be provided with the medical reason for the classification, using the military medical code number.

The norms for the classification have varied somewhat during the period in question here. In earlier years they were less strict, as may be inferred from the large number who were exempted from military service, particularly during the early nineteen-thirties. For reasons of national economy, fewer of those in the relevant age groups were called up during these years. On the other hand, most of those who had been exempted from military service at this time were re-examined about 1942 and then underwent military training.

Most of the subjects in the present investigation served their first term of military service between 1923 and 1942 and were, as a rule, called up repeatedly between 1939 and 1945. There are scarcely any other age groups in Sweden about whom so much information is available with regard to the physical condition and military suitability. Since the upper borderline for liability to military service was raised from 45 to 47 years of age about 1940, they could be followed up until a relatively high age.

From my point of view, the military records nevertheless had a drawback, in that they only take the current situation into account and only list those who are still liable to military service. Thus, all those born in 1902 and a large number of those born in 1903 had been taken off the records in 1950 before my investigation had been completed. Moreover, those unfit for service were struck from the records in such a way that it was practically impossible to discover the diagnosis in more than a few cases. It was, however, possible — by means of comparisons between the central military registers and the data in the parish registers — to ascertain with considerable certainty the number of those denoted as unfit for military service. Those who were initially exempted from active service were either called up later or were definitely declared to be unfit.

In many cases it was also impossible to obtain complete information regarding the diagnoses for those in grades 3 and 4; no account is therefore given of them here. During the course of their military service, a number of conscripts were moved to another grade than that under which they were originally classified, owing to subsequent physical or mental illness. The fitness classifications recorded in the following are those applying in 1950—1951.

The account of the follow-up investigation in the military records covers the following points. The length and weight on enrolment, which in almost every case was that at the age of 20 years. — The final fitness classification in 1950. — When applicable, military promotion.

TABLE 34

Mean body weight on enrolment in military service: classification according to birth weight group (prematures and controls).

($M \pm \varepsilon(M)$ = Mean $\pm$ standard error of the mean. σ = Standard deviation.)

Birth weight: grams	Mean weight on enrolment: kg					
	Single births			Multiple births		
	n	$M \pm \varepsilon(M)$	σ	n	$M \pm \varepsilon(M)$	σ
1 010—2 000.....	35	60.6 $\pm$ 1.2	7.2	25	63.2 $\pm$ 1.8	9.2
2 010—2 250.....	99	64.0 $\pm$ 0.7	7.3	37	67.7 $\pm$ 1.1	6.5
2 260—2 500.....	206	64.7 $\pm$ 0.6	8.2	35	63.3 $\pm$ 1.3	7.7
2 760—3 250.....	183	66.1 $\pm$ 0.5	7.3	9	62.8	
3 260—3 750.....	357	67.4 $\pm$ 0.4	7.2	2	63.0	
Mean weight for 340 single-born prematures 1. 64.0 $\pm$ 0.4 kg Mean weight for 97 plural-born prematures 2. 65.0 $\pm$ 0.8 » Mean weight for 540 single-born controls 3. 67.0 $\pm$ 0.3 » Difference: 1—3: 3.0 $\pm$ 0.5 kg						

Conscripts less than 157 centimeters tall are automatically down-graded to grade 3 or 4 and they cannot join the standing army. No upper borderline is fixed, except that conscripts above a certain height are not assigned to some branches of the armed forces.

The mean height of conscripts in Sweden has risen successively during recent years. Thus it increased from 172.1 centimeters in 1921—1925 to 174.5 centimeters in the beginning of the nineteen-forties. This fact has usually been ascribed to the improvement in the nutritional standard and in the general social standard.

On the other hand, prematurely born children have a higher vitamin requirement and a greater need of adequate nutrition, owing to their relatively more rapid growth during the first year of life. The prematurely born children did not have the benefit of prophylaxis against rickets in the modern sense and it is probable that in many cases the controls also suffered from vitamin D deficiency. Moreover, the northerly position of Sweden gives rise to an increased incidence of rickets during the long, dark season. A high incidence of rickets, often of a severe degree, was presumably present in both series, as has been reported in most of the literature from the same period. Deficiency of vitamin D and of other vitamins may have affected the more rapidly growing organism to a greater extent than that growing normally.

Other nutritional, social and economic factors presumably affected both series to the same degree, or may have had a greater effect on the children in the control series. In the latter case, this would be associated with the fact that only those who survived the age of 20 were included in the calculations of the height and body weight. Thus, there was a relatively larger number in the control series with a father belonging to social group III than in the series of prematurely born children.

A comparison was made between those in each series born between 1902 and 1911 and between 1912 and 1921, respectively. It gave the following results. In the single-born prematures, the mean height increased from 171.4 ± 0.6 centimeters in the first period to 173.6 ± 0.2 centimeters in the second period. The difference, 2.2 ± 0.8 centimeters, is statistically probable. The mean height of the plural-born prematures increased correspondingly from 171.2 ± 1.1 centimeters to 174.2 ± 0.9 centimeters. The difference is 3.0 ± 1.4 centimeters. The mean height of the single-born controls increased from 174.8 ± 0.5 centimeters to 176.1 ± 0.3 centimeters. The difference is 1.3 ± 0.6 centimeters. The mean weight in the respective series also increased from the first period to the second, but only to an extent corresponding to the increase in the height.

If any conclusion can be drawn from the foregoing figures, it is chiefly that there was a more marked tendency to an increase in height among those prematurely born than among the controls. It is therefore possible that the statistically probable difference found in the height might become evened out with improved prophylactic measures.

TABLE 35

Rohrer's index on enrolment in military service.

($M \pm \varepsilon(M)$ = Mean $\pm$ standard error of the mean.)

Birth weight: grams	Single births		Multiple births	
	No.	$M \pm \varepsilon(M)$	No.	$M \pm \varepsilon(M)$
1 010—2 000.....	34	1.23 ± 0.031	25	1.30 ± 0.042
2 010—2 250.....	98	1.25 ± 0.017	37	1.26 ± 0.025
2 260—2 500.....	205	1.24 ± 0.012	34	1.20 ± 0.029
2 760—3 250.....	183	1.25 ± 0.012	9	1.23
3 260—3 750.....	355	1.23 ± 0.008	2	1.12

A calculation of the body type according to Rohrer's index is recorded in Table 35. No convincing differences whatsoever could be shown between the respective series, nor between the different birth weight groups.

important reason for this difference is the difference in the height and body weight. Because only relatively incomplete data could be obtained concerning the medical reasons for which the conscripts in question were exempted from military service, no attempt has been made to analyze these conditions.

4. Promotion

The question arises of how the conscripts conducted themselves during their military service. I therefore calculated the incidence of those who, on the grounds of military suitability, special training or other factors of value for military purposes, were promoted to warrant officers, non-commissioned officers or officers. Such possibilities were open almost exclusively to those in grades 1 and 2. I therefore calculated the incidence only on the number of those in these two grades. Of the premature single-born children, 42 out of 280, *i.e.*, 15.0 ± 2.1 per cent, were promoted. The corresponding figure for the plural-born prematures was only 4 out of 82, *i.e.*, 4.9 ± 2.4 per cent, whereas it was 58 out of 473, *i.e.*, 12.3 ± 1.5 per cent, for the single-born controls. Strangely enough, there is a statistically significant difference only between the single-born and the plural-born prematures and not between the single-born children in the two series. The differences are 10.1 ± 3.1 per cent and 2.7 ± 2.6 per cent, respectively. In any event, the number of premature plural-born children in this analysis is too small to permit any generally applicable conclusions. It is, however, evident that those of the prematurely born children who were called up served their term of military service as satisfactorily as did those in the control series.

CHAPTER IX

Social and Economic Conditions at Adult Age

1. Social Groups

The next step in the investigation was an analysis of the social conditions and social adaptation of the subjects in the series. The occupation, classified into one of the three social groups described earlier (*cf.* p 51) was used as the standard for the evaluation. A comparison was made both between the subjects (sons) and their fathers and between the subjects in the respective series.

There was a difference of 20 years between the oldest and the youngest subjects in my series; the social and economic problems with which they were faced at the same age were not, therefore, the same. In many respects, the social structure of Sweden has undergone radical changes during these 20 years and during the subsequent 26 years up to the end of the investigation period on January 1st, 1948.

Some idea of the background must be given. Although Sweden did not take part in World Wars I and II, the neighbouring countries were involved. As a result, the country was in a state of high military preparedness and was, to a great extent, isolated from the foreign market. The world-wide fluctuations in the state of the market were also reflected in Sweden. There were periods of widespread unemployment, particularly in 1921—1922 and 1932—1934. During the years covered by the investigation, Sweden has become strongly industrialized with a resulting relatively large exodus of the rural population to towns and urban districts.

Central administration has become more extensive, with a resulting larger number of posts in government and communal offices. A considerable increase has also taken place in the number of administrative staff in large private enterprises. Moreover, greater possibilities have been opened up for vocational training and higher studies, even for those with low incomes.

These factors have brought about changes in the social structure and, particularly in Stockholm, a relative increase in the numbers in social groups I and II. For the country as a whole, the respective incidences for social groups I, II and III have, however, remained almost constantly at 5 per cent, 40 per cent and 55 per cent. These figures are based on the election statistics for those entitled to vote for the election of members of the second chamber

TABLE 37

Social group of the surviving subjects in comparison to that of the father
(rise or fall in social scale).

Social group compared to that of father	Prematures		Controls Single-born 3.
	Single-born 1.	Plural-born 2.	
Incidence calculated on	544	148	848
Percentage with social group higher than father I	31.6 ± 2.0	19.6 ± 3.3	36.7 ± 1.7
Percentage with social group lower than father II	8.5 ± 1.2	9.5 ± 2.4	8.3 ± 0.9
Difference for I: 1—3: 5.1 ± 2.6 per cent 1—2: 12.0 ± 3.8 » » Difference for II: 1—3: 0.2 ± 1.5 » » 1—2: 1.0 ± 2.1 » »			

of the Riksdag, according to the Act of 1918, *i.e.*, the definite establishment of general franchise for both sexes.

Certain difficulties are encountered in determining the social group to which the individual should be assigned, even though such a classification has been used in the election statistics in Sweden since 1911. In addition to the purely technical difficulties in assessing the occupations, there is the problem caused by the tendency in recent years to up-grade the posts. (For example, some years ago a clerk in an office would have been designated as such, whereas today an individual in the same position is more likely to be called a manager's assistant or a cashier.) This tendency nevertheless has a slighter effect on a classification into three groups only than on a more detailed classification into five social groups.

Another factor of importance is that the social group of the fathers was recorded at the time the child was born, whereas that of the sons was, in most cases, evaluated up to January 1st, 1948. This implies that the social group of the fathers was evaluated at a mean age of about 30 years and that of the sons at the mean age of about 35 years. If it is assumed that the final social standing is usually reached only after 30 years of age, the assessment of the final social position is more definite for the sons than for the fathers. The social group to which the sons belonged could be checked in several registers, whereas that of the fathers was based on the statement in the baptismal register alone. None of these factors should, however, affect a mutual comparison between the series.

TABLE 38

Percentage distribution of the social groups: surviving subjects in the present series and their fathers.

Social group		Prematures		Controls Single-born 3.
		Single-born 1.	Plural-born 2.	
Incidence calculated on (fathers and sons)		544	148	848
Sons	I	10.1 ± 1.3	10.8 ± 2.6	12.4 ± 1.1
	II	44.3 ± 2.1	39.2 ± 4.0	44.0 ± 1.7
	III	45.6 ± 2.1	50.0 ± 4.1	43.6 ± 1.7
Fathers	I	5.5	8.8	4.8
	II	29.0	32.4	26.7
	III	65.4	58.8	68.5
Differences between sons: Social group I: 1—3: 2.3 ± 1.7 per cent				
Social group III: 1—3: 2.0 ± 2.7 » »				
III: 1—2: 4.4 ± 4.6 » »				

Table 37 shows the number of sons in the respective series who rose one or two social groups above that of the father and the number of those who were assigned to one or two groups lower.

In studying Table 37 it must be recalled that the mortality rate was not the same in the respective series. A larger number of the premature plural-born children than of the premature single-born died at an early age and there was a higher mortality among the prematurely born children than among the controls. Moreover, the mortality was consistently highest in social group III and lowest in social group I. From this point of view, the most favourable initial social situation of the surviving sons was in the following order: premature plural-born, premature single-born and controls. On the other hand, the possibilities of rising socially are not so great with a higher initial social position, at any rate when a classification into only three social groups is used. This may explain to some extent the higher incidence of a rise among the single-born than among the plural-born prematures and the tendency to a corresponding difference between the single-born prematures and the single-born controls. No difference whatsoever is present between the respective series as far as a fall in the social scale is concerned. Table 38 shows the percentage distribution among the three social groups for the respective series. No significant differences are present.

To sum up, the following statements may be made. In the present series, the distribution among the three social groups of those of the prematurely born children who survived until adult age was, on the whole, the same as that of the controls. In an attempt to assess the changes occurring in the social status, a difference was found with respect to the number of those who had attained a higher social group than that of the father, the incidence being higher among the single-born controls than among the single-born prematures and among the single-born prematures than among the plural-born prematures. These differences may be partly explained by the fact that the incidence of the surviving subjects belonging initially to the two higher social groups in the respective series was as follows: plural-born prematures *41.2 per cent*, single-born prematures *34.5 per cent*, single-born controls *31.5 per cent*.

2. Public Assistance

The next stage in the investigation of the social and economic prognosis was a study of the Social Welfare Register of the City of Stockholm. I investigated the number of those in the three series who had been recipients of some form of public relief. This applied only to the time during which they were resident in Stockholm, since such relief is usually paid out by the communal authorities.

The various forms of relief were divided into the following four main groups:

- a) Poor relief.
- b) Unemployment relief.
- c) Sickness relief, which was mainly in the form of free hospital care for lengthy illness of the subject himself or, when he was the family provider, of members of his family.
- d) Other forms of relief for the subject himself or for members of his family.

The norms for the payment of relief have varied somewhat during the period in question. In general, the possibilities of public assistance have increased considerably during the last 10 years in question, *i.e.*, up to January 1st, 1948. Unemployment relief has also varied; between 1932 and 1934 unemployment was fairly common in Sweden and then affected, out of all those belonging to the various trades unions, 25—30 per cent in the winter and 15—20 per cent in the summer. Normally, there is always some such unemployment, owing to the seasonal nature of certain work. During a boom, it usually affects 5—8 per cent of all workers during the winter and 2—4 per cent during the summer (DAHLBERG and TINGSTEN 1937).

It was not possible to ascertain the exact number of residents in Stockholm, either for each calendar year or for each year of life. No calculations could therefore be made of the chances of receiving some form of relief. Thus,

TABLE 39

Recipients of public relief listed in the Social Welfare Register of the City of Stockholm.

Form of relief	Prematures		Controls Single-born 3.
	Single-born 1.	Plural-born 2.	
Incidence calculated on	362	103	602
Poor relief	20.4 ± 2.1	22.3 ± 4.1	21.8 ± 1.4
Unemployment relief	16.9 ± 2.0	21.3 ± 4.0	14.6 ± 1.4
Free hospital care	10.2 ± 1.6	10.7 ± 3.1	12.1 ± 1.3
Other relief	17.1 ± 2.0	23.3 ± 4.2	18.1 ± 1.6
The differences between groups 1 and 3 and 1 and 2, respectively, are not statistically significant			

only the incidence figures are given for the recipients of the various forms of relief (Table 39).

The incidence was calculated on the number of those in residence groups I and II described earlier (*cf.* p 70), *i.e.*, those who had lived for their whole life, or for the greater part of it, in Stockholm. Presumably, this basis for the calculations implies that the figures are somewhat too high. Comparisons can therefore be made only between the respective series. If this raised incidence were to affect one of the series more than the others, it would be the single-born prematures, since the incidence of moves from Stockholm was slightly higher in their case. The controls are presumably those least affected by these raised figures (Table 28).

As a rule, a person may not be the recipient of both poor relief and unemployment relief simultaneously. The number of months during which relief was received was therefore calculated and a comparison made between the number of such months per recipient in the respective series. Finally, the corresponding figures are recorded for those resident in Stockholm for their whole life or the major part of it (Table 40). In this table as well, the figures are certainly too high, since in some cases relief was only received during part of a month. The figures for the respective series are, however, comparable.

Briefly, it may be stated that no significant differences are present between the respective series with regard to the forms of relief in question. The incidence figures were lowest for the premature single-born children in every instance with the exception of unemployment relief. The relatively high incidence of unemployment relief among the premature plural-born children is compensated for by the fact that the number of months during which

TABLE 40

Number of months during which either poor relief or unemployment relief was received.

	Prematures		Controls Single-born 3.
	Single-born 1.	Plural born 2.	
Months of poor relief	1 093	347	1 902
No. of recipients	74	23	131
Months of relief per individual	14.8	15.1	14.5
Months of unemployment relief	591	172	816
No. of recipients	61	22	88
Months of relief per individual	9.7	7.8	9.3
Total months of relief	1 684	519	2 718
No. of residents in Stockholm	362	103	602
No. of months of relief per individual in the series	4.7	5.0	4.5

such relief was received is less than in the other series. As already mentioned, the calculations of the incidence based only on residence groups I and II presumably result in slightly too high percentage figures for the premature single-born children. This also applies, although to a lesser extent, to the premature plural-born children. On the other hand, the surviving children in the series of prematures had a higher initial social situation; this might have given them an advantage over the controls. It is scarcely possible to calculate the numerical importance of these factors. It is, however, evident that the prematurely born children in my series were not a greater burden on the community at adult age than were the controls.

3. Taxable Income

It was shown in the preceding section that no difference existed between the prematurely born children and the controls with respect to the reception of some form of relief from the City of Stockholm. The question then arises of the income derived from employment.

An investigation was therefore made of the taxable income for 1946 and 1947 of those resident in Stockholm. The arithmetic mean for the "estimated taxable income" as assessed by the Inland Revenue Office was used as the norm for the comparison. These years were chosen for the following reasons. The same record number on the income-tax demand was used for both years. The first of these years was tax-free in connexion with the change-over to

TABLE 41

Classification according to net income during 1946 and 1947:
subjects resident in Stockholm.

Income: Swedish Crowns	Prematures				Controls Single-born 3.	
	Single-born 1.		Plural-born 2.			
	No.	Per cent	No.	Per cent	No.	Per cent
Less than 4 000	35	9.6	3	3.5	37	6.3
4 000—6 000	150	41.0	44	51.8	205	35.1
6 000—8 000	113	30.9	27	31.8	209	35.8
More than 8 000	68	18.6	11	12.3	133	22.8
Total	366	100.0	85	100.0	584	100.0
Mean	6 540 Sw. Cr		6 010 Sw. Cr		7 190 Sw. Cr	
Median	6 080 Sw. Cr		5 900 Sw. Cr		6 270 Sw. Cr	

taxation at the source. There was a trade boom and practically all available labour was employed.

Estimated taxable income denotes, on broad lines, the taxable income when approved deductions for certain purposes have been made, *i.e.*, it is the net income from employment. It was, as a rule, possible to include only the figures for earned income and not those for unearned income. Information regarding the taxable income for the years in question could be obtained for 366 of the premature single-born children, 85 of the premature plural-born and 584 of the controls. The relevant figures are recorded in Table 41.

A comparison between the median for the respective series shows no definite difference between them. In this respect, the median gives a more accurate estimation than the mean, since a few persons with a particularly high income may influence the figures, owing to a skew distribution.

4. Criminality

In order to obtain further information about the social adaptation of the subjects in my series, I ascertained the number who had been convicted of some crime. This was done by a study of the Penal Register of the National Prison Board, which covers the whole of Sweden. All those over 15 years of age who have been sentenced to imprisonment or to penal servitude since 1900 are listed in this register. It also lists those given a suspended sentence and those released on parole, as well as those whose sentences were remitted on

TABLE 42

Subjects convicted of crimes and listed in the Penal Register.

Nature of crime	Prematures		Controls Single-born 3.
	Single-born 1.	Plural-born 2.	
Incidence calculated on	516	144	813
Crimes against property, receiving stolen goods	17	2	39
Assault and battery	1	—	3
Sexual crimes	3	—	2
Drunken driving	1	—	2
Military defections	2	1	3
Rioting	1	1	1
Miscellaneous	5	1	19
No. convicted	30	5	69
Percentage	5.8 ± 1.0	3.5 ± 1.5	8.5 ± 1.0
No. convicted once	19	2	48
Percentage	3.7	1.4	5.9
Differences: 1—3: 2.7 ± 1.4 per cent			
1—2: 2.3 ± 1.9 » »			

the grounds that they were not responsible for their actions at the time of the offence.

The Swedish penal system has been reformed several times during the period in question here and a considerable "humanization" has taken place. Increasing emphasis has been laid on preventive measures and there is a growing trend to give suspended sentences to young persons and to first offenders. There is also an increasing tendency to place the supervision of such persons in the hands of the social welfare authorities, who must be considered to have the greatest possibilities for helping to rehabilitate them.

These reforms, which have mainly influenced the application of the penal laws should not, however, affect comparisons between the present series. The account given here covers the following points. The nature of the crimes, with a classification into a number of main groups. — The incidence of crimes, both for first offenders and for those convicted more than once. — The annual risk and the cumulative risk, calculated for five-year periods. (See Tables 42 and 43.)

A study of these tables discloses the following. There is a tendency to a lower incidence of crimes among those prematurely born than among the

TABLE 43

Percentage annual risk in 5-year periods of being convicted for the first time of crime.

Age: years	No. of yrs. of observation	No. of subjects convicted	Average annual risk: per cent	Cumulative risk: per cent
<i>Single-born prematures</i>				
15—20.....	2 770	11	0.40	2.00
20—25.....	2 667	9	0.34	3.70
25—30.....	2 405	5	0.21	4.75
30—35.....	1 663	4	0.24	5.95
35—40.....	853	1	0.10	6.45
40—45.....	274			6.95
<i>Single-born controls</i>				
15—20.....	4 271	26	0.61	3.05
20—25.....	4 057	19	0.47	5.40
25—30.....	3 679	16	0.43	7.55
30—35.....	2 578	6	0.23	8.70
35—40.....	1 365	2	0.11	9.25
40—45.....	484			9.80

controls. A possible contributory factor is that mentioned earlier, *i.e.*, owing to the excess mortality among the prematurely born children in social group III, the initial social status of those children who survived was higher, evaluated according to the social group of the father, than that of the controls.

Premature birth may also have an effect on the personality development. On one hand there is the "rigid type of post-natal care". On the other hand, there must be a particularly strong emotional bond between the mother and these more than normally helpless children. This should apply especially in a series such as the present one. The premature children were all born in wedlock and there was probably a high incidence of those whose birth was welcomed by the parents. In Sweden at any rate, the prematurely born children of unmarried mothers were presumably only infrequently welcome. At the beginning of the present century, it was certainly not the rule for the parties in question to marry only because the woman was pregnant. Owing to the nature of the present investigation, little information was, however, obtained regarding the home conditions and such factors as divorce and broken homes.

5. Temperance Infractions

The Swedish legislation governing the manufacture and sale of alcoholic drinks and the treatment of the abuse of alcohol is somewhat complicated. I shall not, therefore, enter into the details here.

In principle, the supervision of alcohol addicts is in the hands of the communal authorities, the temperance committees (*nykterhetsnämnder*). The control of the sale of alcoholic drinks and of temperance infractions is in the hands of a state organization, the National Liquor Control Board. Since 1932 it has its own penal register, which lists temperance infractions, and crimes and misdemeanours committed under the influence of alcohol. Especially since 1938, the courts are obliged to report to this Board those who have been convicted of such offences.

The account of these matters in the present series (Tables 44 and 45) is recorded, on the whole, in the same way as in the case of other crimes (see preceding section).

This part of the investigation did not show any significant difference between the three series. There is not even a numerical difference between the single-born prematures and the single-born controls. There is a slight tendency, but only at a higher age, to a higher incidence of temperance infractions among those born prematurely. It does not, however, permit any general conclusions to be drawn.

The study of the Penal Register and of the register of the National Liquor Control Board thus showed that, in these respects, those prematurely born

TABLE 44

Incidence of convictions for drunkenness and annual risk of being convicted for the first time of drunkenness.

	Prematures		Controls Single-born 3.
	Single-born 1.	Plural-born 2.	
Incidence calculated on	516	144	813
No. with known convictions	57	22	89
Percentage	11.0 ± 1.4	15.3 ± 3.0	10.9 ± 1.1
No. with one conviction	37	14	59
Percentage	7.2	9.7	7.3
Differences: 1—3: 0.1 ± 1.8 per cent			
1—2: 4.3 ± 3.3 » »			

TABLE 45

Percentage annual risk in 5-year periods of being convicted for the first time of drunkenness.

Age: years	No. of yrs. of observation	No. of subjects convicted	Average annual risk: per cent	Cumulative risk: per cent
<i>Single-born prematures 1</i>				
15—20	2 788	2	0.07	0.35
20—25	2 692	15	0.56	3.15
25—30	2 407	14	0.58	6.05
30—35	1 635	15	0.91	10.60
35—40	819	7	0.85	14.85
40—45	266	4	1.50	22.35
<i>Plural-born prematures 2</i>				
15—20	736	—	—	0
20—25	721	9	1.25	6.25
25—30	617	8	1.30	12.75
30—35	404	2	0.74	16.45
35—40	197	3		20.15
40—45	73	—		23.85
<i>Single-born controls 3</i>				
15—20	4 306	7	0.16	0.80
20—25	4 137	25	0.60	3.80
25—30	3 700	27	0.73	7.45
30—35	2 579	21	0.81	11.50
35—40	1 339	7	0.52	14.10
40—45	491	2	0.41	16.15

did not exhibit asocial behaviour to any greater extent than did the controls. Moreover, the cumulative risks for the single-born prematures of being sentenced for crimes are consistently lower than the mean figures for the male population in towns in Sweden (DAHLBERG 1948). The corresponding risk figures for the controls are almost identical with these mean figures.

It must, however, be pointed out that in series such as the present, the reliability of the figures decreases considerably after 35 years of age, owing to the relatively small number of the subjects observed after this age. This also applies to the cumulative risk of being recorded in the register of the National Liquor Control Board. The rapid increase in the figures for the cumulative risk for both the single-born and the plural-born prematures cannot be accorded any great importance, since the number of years of observation decreases sharply for the 5-year periods after 35 years of age.

General Summary

It is evident from the review of the literature (*Chapter II*) that opinions regarding the mental and physical prognosis for prematurely born children are at variance, as are the figures obtained in the different investigations. This is presumably due mainly to the differences in the respective series with regard to such factors as the social status and post-natal care and to the fact that the series were often small and comparisons were seldom made with comparable control series.

The present series of prematures consists of 999 boys with a birth weight of 2500 grams or less, born at the three largest maternity hospitals in Stockholm between 1902 and 1921. They were all born in wedlock and were discharged alive from hospital. The control series consists of 1002 so-called social twins with a birth weight between 2760 and 3750 grams (Tables 1-3).

Comparisons are, as a rule, made between the following three series:

1. 759 premature single-born children
2. 240 premature plural-born children
3. 981 single-born controls.

See Tables 4-6.

An account of the obstetric, paediatric and social conditions is given in *Chapter IV* (Tables 7-17). On the whole it confirms already established facts, but also serves as a basis for the subsequent steps in the investigation. A summary of these conditions is recorded in Table 18.

The mortality among those children discharged alive from the maternity hospitals is reported in *Chapter V* (Tables 19-27). The results may be summarized as follows:

A. As could be expected, the mortality rate is higher for the prematurely born children than for the controls, even though all the children were discharged alive from hospital. The difference in the mortality is greatest during the first months of life and does not become evened out until 2-3 years of age (Tables 25 and 26). The difference is caused mainly by a considerable excess mortality from infectious diseases among the prematurely born children (Table 20). The mortality is highest among those in the lowest birth weight group (Table 22), those in the lowest social group (Table 23), those whose mothers were ill during pregnancy (Table 24) and those with several older siblings (Table 27).

B. A comparison between the single-born and the plural-born prematures discloses the surprising fact that the mortality is consistently higher for the plural-born children. This difference between the two series of prematurely born children is statistically probable, both for the total mortality and for the mortality from infectious diseases (Table 20). In social group III, the difference is statistically significant (Table 22). The higher mortality rate for the plural-born premature children as compared to the single-born prematures applies when the birth weight is the same in both categories (Table 22) when the condition of the mother during pregnancy is the same (Table 24) and with the same birth order number (Table 27).

An account is given in *Chapter VII* of certain physical and mental deviations from the norm, *i. e.*, mental developmental disturbances, diseases resulting in mental or physical disablement and tuberculosis. Only the percentage figures are given here, as well as the differences between the single-born prematures (1) and the single-born controls (3).

A. Mental developmental disturbances

	1	2	3
		Per cent	
a. Pupils in Special Classes (Table 29)	3.3	5.8	1.7
Difference 1-3: not significant.			
b. Institutional care (Table 30)	4.8	2.1	1.2
Difference 1-3: statistically significant.			
c. Pensions: spastic paralysis, epilepsy, educable and ineducable mental deficiency (Table 31)	3.5	2.8	0.7
Difference 1-3: statistically significant.			
<i>n. b.</i> the same individual is frequently recorded under a, b and c.			

B. Disabling physical diseases

	1	2	3
		Per cent	
Other illnesses than those under A entitling to a pension (Table 31)	3.1	0	3.0
Difference 1-3: not significant.			

C. Tuberculosis

	1	2	3
		Per cent	
a. Morbidity (Table 32)	11.0	14.6	13.0
Difference 1-3: not significant.			
b. Mortality after 1 year of age (Table 32)	3.6	2.8	3.8
Difference 1-3: not significant.			

The physical development at adult age and the fitness for military service are evaluated on the basis of the notations in the military registers (*Chapter VIII*).

	1	2	3
		Per cent	
a. Fully fit for active service (Table 36)	56.2	62.6	63.8
Difference 1-3: not significant.			
b. Unfit for active service (Table 36)	17.1	15.3	12.5
Difference 1-3: not significant.			
c. Military promotion of those fully fit	15.0	4.9	12.3
Difference 1-3: not significant.			
d. Mean height at 20 years of age (Table 33)	172.8 cm.	172.9 cm.	175.6 cm.
Difference 1-3: statistically significant.			
e. Mean body weight at 20 years of age (Table 34)	64.0 kg.	65.0 kg.	67.0 kg.
Difference 1-3: statistically significant.			

The social and economic prognosis is assessed from several aspects (*Chapter IX*). In the following table, the majority of the data are given as the percentages.

	1	2	3
		Per cent	
a. The social group of the subject (Table 38)			
Social group I	10.1	10.8	12.4
Social group III	45.6	50.0	43.6
b. Various forms of public relief (Table 39)			
Unemployment relief	16.9	21.3	14.6
Poor relief	20.4	22.3	21.8
Sickness relief	10.2	10.7	12.1
Other relief	17.1	23.3	18.1

Here as well, it must be recalled that the same individual may have received more than one form of relief.

	1	2	3
c. Median for net income in Swedish crowns (Table 41) . .	6080	5900	6270
d. Convictions for crime (Table 42) per cent	5.8	3.5	8.5
Convictions for drunkenness (Table 44) per cent . . .	11.0	15.3	10.9

There are no statistically significant differences between 1 (premature single-born children) and 3 (single-born controls) with regard to any of the social and economic conditions listed in the foregoing.

Conclusions

Thus, a comparison is made between a relatively uniform series of prematurely born children, whose initial social status was not markedly poor, and a control series of children for whom the conditions were similar to that of the prematures in most respects, but whose birth weight was normal. Such a comparison permits the following conclusions to be drawn, at any rate with regard to the present series:

1. The mortality rate is considerably higher among the prematurely born children during the first two years of life, particularly among the plural-born prematures.

2. Among those prematurely born children who survive the first two to three years of life, there is a moderately higher incidence of such disorders that are usually considered to be associated with birth injuries than among the controls. The difference is statistically significant. In other respects, and with regard to other disabling diseases and tuberculosis, there is no difference between the prematurely born children and the controls.

3. There is a statistically significant difference between the height and body weight at 20 years of age in the two categories, the figures being lower for those prematurely born than for the controls. The incidence of those able to do their military service is practically the same in both categories and those prematurely born performed their military duties, on the whole, as well as did the controls.

4. As regards social adaptation, there are no statistically significant or probable differences between the prematurely born children and the controls. The general impression is that under no conditions were they more of a burden on the community than were the controls and that, in the majority of respects, they did as well as the controls.

Résumé

Ainsi qu'il ressort du *Chapitre II* dans lequel fut passée en revue la littérature, les pronostics sur l'évolution mentale et physique des enfants prématurés présentent de grandes variations, de même que font les résultats obtenus au moyen des différentes enquêtes. Ceci peut être attribué aux différences des séries respectives, particulièrement en ce qui concerne certains facteurs tels que la situation sociale et les soins post-nataux. De plus, les séries étaient souvent réduites et il fut rarement procédé à des comparaisons entre elles et des séries de cas-témoins.

La série suivante d'enfants prématurés consiste de 999 garçons nés dans les trois plus grandes maternités de Stockholm, entre les années 1902—1921. Leur poids à la naissance était de 2.500 grammes et moins. Les cas considérés

sont uniquement des enfants légitimes, ayant quitté la maternité vivants. La série de cas-témoins consiste de 1.002 «jumeaux sociaux», ayant à la naissance un poids entre 2.760 et 3.750 grammes (Tab. 1—3).

En principe, les comparaisons sont faites entre les trois séries suivantes:

1. 759 enfants prématurés, naissances simples,
2. 240 enfants prématurés, naissances multiples,
3. 981 cas-témoins, naissances simples.

Voir Tables 4—6.

Dans le *Chapitre IV* (Tab. 7—17) est donné un aperçu sur les conditions obstétriques, pédiatriques et sociales concernant les enfants. En gros, il ne fait que confirmer un certain nombre de faits déjà établis. Cependant, il peut être utilisé comme base aux enquêtes ultérieures. On trouvera un résumé de ces conditions dans le tableau 18.

Au *Chapitre V*, on trouvera un aperçu sur la mortalité enregistrée parmi les enfants ayant quitté vivants la maternité (Tab. 19—27). Les résultats peuvent être résumés ainsi qu'il suit:

A. Ainsi que l'on pouvait s'y attendre, le taux de mortalité parmi les enfants prématurés est plus élevé que celui enregistré parmi les cas-témoins. La différence entre ces deux taux de mortalité est surtout sensible au cours des premiers mois, et ne s'aplanit qu'à l'âge de 2 à 3 ans (Tab. 25 et 26). Cette différence est impliquable principalement à la mortalité occasionnée chez les enfants prématurés par les maladies infectieuses (Tab. 20). On note les taux de mortalité les plus élevés chez: les enfants dont le poids à la naissance est le moindre (Tab. 22), les enfants originaires du groupe social le plus bas (Tab. 23), les enfants dont la mère fut malade au cours de sa grossesse (Tab. 24) et enfin les enfants ayant plusieurs frères ou sœurs plus âgés (Tab. 27).

B. Une comparaison entre la série de prématurés, naissances simples, et celle de prématurés, naissances multiples, fait ressortir ce fait surprenant: le taux de mortalité est sensiblement plus élevé chez les enfants nés jumeaux ou multiples que chez les enfants nés seuls. Cette différence entre les deux séries d'enfants prématurés est statistiquement probable, et pour le taux de mortalité totale, et pour le taux de mortalité due à des maladies infectieuses (Tab. 20). La différence a une signification statistique dans le groupe social III (Tab. 22). Même quand le poids à la naissance est le même pour les sujets des deux séries d'enfants prématurés, la différence entre les deux taux de mortalité apparaît (Tab. 22). Il en va de même quand la condition de la mère est identique pendant la grossesse (Tab. 24), et le numéro d'ordre de naissance également identique (Tab. 27).

Dans le *Chapitre VII* est donné un aperçu sur quelques anormités physiques et mentales, telles que l'arriération mentale, maladies résultant en invalidité

physique ou mentale et la tuberculose. Seules les données procentuelles sont indiquées, de même que les différences entre les enfants prématurés, naissances simples (1) et les cas-témoins, naissances simples (3).

A. Troubles du développement mental

	1	2 %	3
a. Elèves en classes spéciales (Tab. 29).	3.3	5.8	1.7
Différence 1—3: sans signific.			
b. Soins en établissements spéciaux (Tab. 30).	4.8	2.1	1.2
Différence 1—3: statistiq. signif.			
c. Pensions: paralysie spasmodique, épilepsie, arriération mentale éduicable et inéducable (Tab. 31) . . .	3.5	2.8	0.7
Différence 1—3: statistiq. signif.			

n. b. le même sujet est souvent enregistré sous a, b et c.

B. Maladies physiques causes d'incapacités

	1	2 %	3
Maladies autres que celles déjà enregistrées sous A et donnant droit à une pension (Tab. 31)	3.1	0	3.0
Différence 1—3: sans signific.			

C. Tuberculose

	1	2 %	3
a. Morbidité (Tab. 32).	11.0	14.6	13.0
Différence 1—3: sans signific.			
b. Mortalité après l'âge de 1 an (Tab. 32)	3.6	2.8	3.8
Différence 1—3: sans signific.			

Le développement physique des sujets à l'âge adulte et leur aptitude au service militaire sont donnés en fonction des consignations enregistrées sur les registres militaires (*Chapitre VIII*).

	1	2 %	3
a. Aptes au service armé (Tab. 36)	56.2	62.6	63.8
Différence 1—3: sans signific.			
b. Inaptes au service armé (Tab. 36)	17.1	15.3	12.5
Différence 1—3: sans signific.			

	1	2	3
		%	
c. Avancement en grade des aptes au service armé	15.0	4.9	12.3
Différence 1—2: sans signific.			
d. Taille moyenne à l'âge de 20 ans (Tab. 33)	172.8 cm	172.9 cm	175.6 cm
Différence 1—3: statistiq. signific.			
e. Poids moyen à l'âge de 20 ans (Tab. 34)	64.0 kg	65.0 kg	67.0 kg
Différence 1—3: statistiq. signific.			

Les pronostics sociaux et économiques sont faits en considération de plusieurs facteurs (*Chapitre IX*). La majorité des données des tables suivantes sont procentuelles.

	1	2	3
		%	
a. Groupe social du sujet (Tab. 38)			
Groupe social I	10.1	10.8	12.4
Groupe social III	45.6	50.0	43.6
b. Formes de secours public (Tab. 39)			
Alloc. chômage	16.9	21.3	14.6
Assistance publique	20.4	22.3	21.8
Alloc. maladie	10.2	10.7	12.1
Secours divers	17.1	23.3	18.1

Ici encore, il importe de souligner que le même sujet peut avoir reçu des secours sous plusieurs formes.

	1	2	3
c. Revenu moyen net en Cour. Suéd. (Tab. 41)	6080	5900	6270
d. Condamnations pour crimes (Tab. 42), en %	5.8	3.5	8.5
e. Condamnations pour alcoolisme (Tab. 44), en % . .	11.0	15.3	10.9

Entre 1 (enfants prématurés, naissances simples) et 3 (cas-témoins, naissances simples) il n'existe pas de différences statistiquement significatives, si l'on considère les conditions sociales et économiques enregistrées précédemment.

Conclusions

Ainsi, une comparaison a été faite entre une série relativement uniforme d'enfants prématurés, ayant une condition sociale de base qui n'est pas caractérisable comme particulièrement pauvre, et une série de cas-témoins, dont les conditions ressemblaient à celles des précédents, mais qui avaient un poids normal à la naissance. De cette comparaison, on peut tirer les conclusions suivantes, en tout cas en ce qui concerne la série en question ici:

1. Le taux de mortalité est considérablement plus élevé au cours des deux premières années chez les enfants prématurés et tout spécialement dans les cas de naissances multiples.

2. Certaines maladies généralement considérées comme étant la conséquence d'accidents lors de la naissance se rencontrent plus fréquemment parmi les enfants prématurés qui survivent l'âge de deux ou trois ans, que parmi les cas-témoins. Cette différence a une signification statistique. Dans les autres domaines, l'on ne rencontre aucune différence entre les enfants prématurés et les cas-témoins, ni quant aux maladies causées d'invalidités et la tuberculose.

3. L'on enregistre une différence statistiquement significative entre les tailles et les poids des deux catégories de sujets ayant atteint l'âge de 20 ans. Les chiffres concernant les enfants prématurés sont inférieurs à ceux concernant les cas-témoins. Le nombre des sujets classés aptes au service armé est sensiblement le même dans les deux catégories de sujets. En somme, les prématurés accomplirent leur service militaire d'une manière aussi satisfaisante que les cas-témoins.

4. En ce qui concerne l'adaptation au milieu social, il n'existe pas de différence ayant une signification statistique ou probable, entre les enfants prématurés et les cas-témoins. Il semble que l'on puisse affirmer que les enfants prématurés ne furent en aucun cas un fardeau spécial pour la société. On peut dire, en effet, que dans la majorité des aspects ils réussirent leur vie aussi bien que les cas-témoins.

Zusammenfassung

Aus der Literaturübersicht geht hervor, dass die Meinungen über die mentale und physische Prognose bei prämaturn geborenen Kindern verschieden sind. Dieses beruht offenbar auf Verschiedenheiten zwischen den Materialien in Hinblick auf die sozialen Verhältnisse, Pflegeverhältnisse etc., sowie auf der Tatsache, dass das Material oft klein war und das selten mit vergleichbarem Kontrollmaterial verglichen wurde. Die in dieser Untersuchung angewandten Fälle sind deshalb auf bestimmte Weise ausgewählt worden: Das Material besteht aus 999 prämaturn geborenen Knaben mit einem Geburtsgewicht von $\approx$ 2500 g., die in den Jahren 1902—1921 in drei Stockholmer

Entbindungsanstalten geboren wurden. Es handelt sich um eheliche Kinder, die lebend aus der Entbindungsstation entlassen wurden. Als Kontrollmaterial dienen 1002 Kinder, sogenannte soziale Zwillinge, deren Geburtsgewicht innerhalb normaler Grenzen liegt. Siehe Tabelle 1—3.

In dieser Untersuchung sind im allgemeinen die folgenden 3 Gruppen miteinander verglichen:

1. 759 prämatüre Einzelgeborene.
2. 240 prämatüre Mehrlingsgeborene.
3. 981 Einzelgeborene aus dem Kontrollmaterial.

Siehe Tabelle 4—6.

In *Kapitel IV* (Tabelle 7—17) wird über die geburtshilflichen, pädiatrischen und sozialen Bedingungen in diesen Gruppen berichtet. In dieser Darstellung werden hauptsächlich bereits bekannte Tatsachen bestätigt, aber sie dient auch als Basis in der folgenden Untersuchung. In Tabelle 18 sind diese Bedingungen zusammengefasst.

Über die Mortalität der lebend aus den Entbindungsanstalten entlassenen Kindern wird in *Kapitel V* Tabelle 19—27 berichtet. Das Resultat kann folgendermassen zusammengefasst werden.

A. Wie zu erwarten war ist die Sterblichkeit in der Gruppe der Frühgeborenen grösser als im Kontrollmaterial, obgleich es sich ja nur um Kinder handelt, die lebend aus der Entbindungsanstalt entlassen wurden. Der Unterschied in der Mortalität ist in den ersten Monaten am grössten und ist nicht vor einem Alter von 2—3 Jahren ausgeglichen (Tabelle 25 und 26). Der Unterschied beruht im Wesentlichen auf der erhöhten Frühgeburtensterblichkeit an Infektionskrankheiten (Tabelle 20), und ist am grössten in den niedrigsten Gewichtsklassen (Tabelle 22), den niedrigsten sozialen Schichten (Tabelle 23), sowie für Kinder kranker Mütter (Tabelle 24) und für Kinder mit mehreren Geschwistern (Tabelle 27).

B. Beim Vergleich von frühgeborenen Einlingen und Mehrlingen zeigt sich die überraschende Tatsache, dass Mehrlinge eine höhere Mortalität aufweisen. Diese Differenz zwischen den Prämatürengruppen ist sowohl im Hinblick auf die Totalsterblichkeit als auch im Hinblick auf die Sterblichkeit an Infektionskrankheiten statistisch wahrscheinlich (Tabelle 20). In der Sozialgruppe III ist der Unterschied gesichert (Tabelle 22). Die höhere Sterblichkeit der frühgeborenen Mehrlinge gegenüber den frühgeborenen Einlingen besteht bei gleichem Geburtsgewicht (Tabelle 22), bei gleichartigem Gesundheitszustand der Mutter (Tabelle 24), sowie bei gleicher Zahl in der Geschwisterreihe (Tabelle 27).

In *Kapitel VII* wird über gewisse geistige und körperliche Abweichungen von der Norm berichtet. Es handelt sich um psychische Entwicklungs-

störungen, hochgradig invalidisierende seelische und körperliche Erkrankungen, sowie Tuberkulose. In diesem summarischen Bericht sind nur Prozentzahlen angegeben. Die Unterschiede werden nur zwischen prämaturen Einlingen (1) und Einzelgeborenen im Kontrollmaterial (3) angegeben.

A. Mentale Entwicklungsstörungen

	1	2 %	3
a. Hilfsschüler, Tab. 29	3.3	5.8	1.7
Differenz 1-3 nicht signifikant.			
b. Anstaltspflege, Tabelle 30	4.8	2.1	1.2
Differenz 1-3 signifikant.			
c. Pension. (Spastiker, Epileptiker und erziehbare und unerziehbare Geistesschwache) Tabelle 31	3.5	2.8	0.7
Differenz 1-3 signifikant.			

Es muss erwähnt werden, dass dieselbe Person oft in Gruppe a., b. und c. einbegriffen ist.

B. Invalidisierende körperliche Erkrankungen

	1	2 %	3
Alle ausser den unter A. angegebenen Erkrankungen, die pensionspflichtig sind, Tabelle 31.	3.1	0	3.0
Differenz 1-3 nicht signifikant.			

C. Tuberkulose

	1	2 %	3
a. Morbidität, Tabelle 32.	11.0	14.6	13.0
Differenz 1-3 nicht signifikant.			
b. Mortalität nach dem 1. Lebensjahr, Tabelle 32. . . .	3.6	2.8	3.8
Differenz 1-3 nicht signifikant.			

Die körperliche Entwicklung im Erwachsenenalter, sowie die Wehrtauglichkeit wurde aus Militärregistern ersehen. *Kapitel VIII.*

	1	2 %	3
a. Voll wehrtauglich, Tabelle 36 . .	56.2	62.6	63.8
Differenz 1-3 nicht signifikant.			
b. Wehruntauglich, Tabelle 36 . .	17.1	15.3	12.5

c. Militärische Beförderung von voll			
Wehrtauglichen	15.0	4.9	12.3
Differenz 1-3 nicht signifikant.			
d. Mittellänge mit 20 Jahren (Tabelle			
33)	172.8 cm	172.9 cm	175.6 cm
Differenz 1-3 signifikant.			
e. Mittelgewicht mit 20 Jahren. Tab.			
34	64.0 kg	65.0 kg	67.0 kg
Differenz 1-3 signifikant.			

Die soziale und ekonomische Prognose wurde unter verschiedenen Gesichtspunkten in *Kapitel IX* beurteilt. Die folgende Tabelle gibt die Angaben in Prozent wieder.

	1	2	3
		%	
a. Die eigene Sozialgruppe des Nachuntersuchten.			
Tabelle 38.			
Sozialgruppe I.	10.1	10.8	12.4
Sozialgruppe III.	45.6	50.0	43.6
b. Verschiedene Formen von Unterstützung. Tabelle 39			
Arbeitslosenunterstützung	16.9	21.3	14.6
Armenunterstützung	20.4	22.3	21.8
Unterstützung bei Krankheit	10.2	10.7	12.1
Übrige Unterstützungen	17.1	23.3	18.1
Auch hier muss erwähnt werden, dass die gleiche Person verschiedene Unterstützungen haben kann.			
c. Mittleres Einkommen in schwedischen Kronen.			
Tabelle 41	6080	5900	6270
d. Für Verbrechen gestraft. %. Tab. 42	5.8	3.5	8.5
Für Trunkenheit gestraft. %. Tabelle 44	11.0	15.3	10.9

Wie aus der oben stehenden Tabelle hervorgeht, besteht zwischen 1 (prä-mature Einzelgeborene) und 3 (einzelgeborene Kontrollen) weder in sozialer noch ekonomischer Hinsicht ein bedeutender statistischer Unterschied.

Wenn man ein so weit möglich homogen ausgewähltes Material von Prä-maturen mit nicht allzu schlechter sozialer Ausgangslage mit einem in meiste Hinsicht gleichartigen Kontrollmaterial mit normalen Geburtsgewicht vergleicht, so lässt sich zusammenfassungsweise folgendes sagen:

1. Die Mortalitätsziffer ist unter den frühgeborenen Kindern innerhalb der ersten beiden Lebensjahre beträchtlich höher und ist besonders bei den prä-maturen Mehrlingen ausgesprochen.

2. Diejenigen, die die ersten 2–3 Jahre überleben, zeigen bei der Nachuntersuchung eine mässige, aber statistisch sichergestellte höhere Frequenz von Leiden, die man mit Geburtsschäden in Verbindung zu setzen pflegt. Was die invalidisierenden Krankheiten oder Tuberkulose betrifft, so besteht zwischen Prämaturen und Ausgetragenen kein Unterschied.

3. Die prämur Geborenen haben noch mit 20 Jahren geringere Körperlänge und geringeres Gewicht als die Kontrollpersonen, was statistisch sichergestellt ist. Sie leisten ihre Wehrpflicht im grossen Ganzen gesehen ebensogut wie die Kontrollpersonen mit normalem Geburtsgewicht.

4. In sozialer Hinsicht bestehen keine statistisch bestätigten oder wahrscheinliche Unterschiede, und als Gesamteindruck kann man sagen, dass die prämur geborenen Personen keineswegs dem Staat mehr zur Last fallen als die Personen mit normalem Geburtsgewicht, und dass sie sich in fast jeder Hinsicht ebenso gut durchsetzen.

Sumario general

De la revisión de la bibliografía se deduce que las opiniones sobre los niños nacidos con prematuridad varían por lo que se refiere al pronóstico mental y físico y así son los valores obtenidos en diferentes investigaciones. Esto es debido probablemente ante todo a las diferencias que existen en las respectivas series con respecto a aquellos factores como el estado social y cuidado postnatal y al hecho de que las series amenudo eran pequeñas y las comparaciones fueron raramente hechas con individuos de control comparables.

La presente serie de prematuros consiste de 999 niños con un peso de nacimiento de 2500 gramos o menos, nacidos en los tres hospitales maternos más grandes de Estocolmo entre 1902 y 1921. Estos nacieron todos en matrimonio y salieron del hospital en vida. Las series de control consisten en 1002 individuos llamados “gemelos sociales” con un peso de nacimiento alrededor de los valores normales (cuadros 1–3).

Las comparaciones fueron hechas, como regla, entre las siguientes tres series:

1. 759 niños prematuros nacidos en número único
2. 240 niños prematuros nacidos en número plural
3. 981 individuos de control nacidos en número único.

Véase cuadros 4–6.

En el capítulo IV (cuadros 7–17) se da cuenta de las condiciones obstétricas, pediátricas y sociales. En general se confirman hechos ya establecidos, pero que sirven de base para la subsiguiente investigación. Un sumario de estas condiciones se encuentra en el cuadro 18.

La mortalidad entre los niños que salieron del hospital maternal en vida se indican en el *capítulo V* (cuadros 19—27). Los resultados son en resumen los siguientes:

A. Como era de esperar la mortalidad es más elevada en los niños nacidos con prematuridad que en los individuos de control, a pesar de que todos los niños salieron con vida del hospital. La diferencia en la mortalidad alcanza su punto culminante durante los primeros meses de la vida y no se sitúa al mismo nivel hasta los dos a tres años de edad (cuadros 25 y 26). La diferencia tiene su causa principal en la alta mortalidad debida a enfermedades infecciosas entre los prematuros (cuadro 20). La mortalidad más elevada se encuentra entre aquellos niños nacidos con el peso más bajo (cuadro 22), entre los nacidos en el grupo social más bajo (cuadro 23), entre aquellos cuyas madres sufrieron enfermedades durante el embarazo (cuadro 24) y entre aquellos con varios hermanos mayores (cuadro 27).

B. Una comparación entre los niños que nacieron en número único o plural nos revela el hecho sorprendente de que la mortalidad es considerablemente mayor entre los niños nacidos en número plural. Esta diferencia entre las dos series de niños nacidos con prematuridad es estadísticamente probable, tanto por lo que respecta la mortalidad total como la mortalidad debida a enfermedades infecciosas (cuadro 20). En el grupo social III, la diferencia es de importancia estadística (cuadro 22). El alto número de mortalidad entre los niños nacidos en número plural en comparación con los prematuros nacidos en número único se evalúa si el peso de nacimiento es el mismo en las dos categorías (cuadro 22), si las condiciones de la madre durante el embarazo son las mismas (cuadro 24) y si el número de orden de nacimiento es el mismo (cuadro 27).

En el *capítulo VII* se da cuenta sobre ciertas devianaciones de la normalidad físicas y mentales, a saber, alteraciones del desarrollo mental, enfermedades que provienen de impedimientos mentales y físicos y tuberculosis. Aquí solamente se dan a conocer los porcentajes así como las diferencias entre los niños prematuros nacidos en número único (1) y los individuos de control (3) también nacidos en número único.

A. *Perturbaciones del desarrollo mental*

	1	2	3
	Por ciento		
a. Discípulos en clases especiales (cuadro 29)	3.3	5.8	1.7
Diferencia 1—3: sin importancia			
b. Al cuidado de instituciones (cuadro 30)	4.8	2.1	1.2
Diferencia 1—3: de importancia estadística			

	1	2	3
	Por ciento		
c. Pensiones: parálisis espástica, epilepsia, deficiencia mental educable y no educable (cuadro 31).	3.5	2.8	0.7
Diferencia 1—3: de importancia estadística.			

adv.: el mismo individuo se registra amenudo entre a, b y c.

B. Enfermedades de imposibilidad física

	1	2	3
	Por ciento		
Otras enfermedades que las que se citan bajo con título pensiones (cuadro 31)	3.1	0	3.0
Diferencia 1—3: sin importancia.			

C. Tuberculosis

	1	2	3
	Por ciento		
a. Morbilidad (cuadro 32)	11.0	14.6	13.0
Diferencia 1—3: sin importancia.			
b. Mortalidad después del 1 ^{er} año de edad (cuadro 32).	3.6	2.8	3.8
Diferencia 1—3: sin importancia.			

El desarrollo físico en la edad adulta y la aptitud para el servicio militar han sido evaluados con la ayuda de las anotaciones de los registros militares (*capítulo VIII*).

	1	2	3
	Por ciento		
a. Aptitud completa para el servicio activo (cuadro 36)	65.2	62.6	63.8
Diferencia 1—3: sin importancia.			
b. No aptos para el servicio activo (cuadro 36)	17.1	15.3	12.5
Diferencia 1—3: sin importancia.			
c. Promoción militar de aquellos completamente aptos	15.0	4.9	12.3
Diferencia 1—3: sin importancia.			
d. Altura media a los 20 años de edad (cuadro 33)	172.8 cm	172.9 cm	175.6 cm
Diferencia 1—3: de importancia estadística.			
e. Peso medio a los 20 años de edad (cuadro 34)	64.0 kg	65.0 kg	67.0 kg
Diferencia 1—3: de importancia estadística.			

El pronóstico social y económico se evalúa de diferentes aspectos (*capítulo IX*). En el cuadro siguiente la mayoría de los datos se dan en el tanto por ciento.

	1	2	3
	Por ciento		
a. Grupo social del individuo (cuadro 38)			
Grupo social I	10.1	10.8	12.4
Grupo social III	45.6	50.0	43.6
b. Formas distintas de socorro público (cuadro 39)			
Socorro sin empleo	16.9	21.3	14.6
Socorro escaso	20.4	22.3	21.8
Socorro de enfermedad	10.2	10.7	12.1
Otras clases de socorro	17.1	23.3	18.1

Hay que recordar aquí que el mismo individuo puede haber recibido más de una clase de socorro.

	1	2	3
	Por ciento		
c. Ingreso medio limpio en coronas suecas (cuadro 41)	6080	5900	6270
d. Pruebas de criminalidad por ciento (cuadro 42) . .	5.8	3.5	8.5
e. Pruebas de embriaguez por ciento (cuadro 44). . .	11.0	15.3	10.9

No existen diferencias de importancia estadística entre 1 (niños prematuros nacidos en número único) y 3 (individuos de control nacidos en número único) por lo que respecta a cualquiera de las condiciones sociales y económicas anotadas en lo antedicho.

Conclusiones

De este modo, se hace una comparación entre series relativamente uniformes de niños prematuros, cuyo estado social inicial no era marcadamente pobre y series de control de niños para los cuales las condiciones fueron parecidas a aquellos de los prematuros en la mayoría de los aspectos, pero cuyo peso de nacimiento era normal. Una tal comparación permite sacar las conclusiones siguientes:

1. La mortalidad es considerablemente más alta entre los niños nacidos con prematuridad durante los dos primeros años de vida especialmente entre los prematuros nacidos en número plural.

2. Entre aquellos niños nacidos prematuramente que sobrevivieron de los dos a los tres años de vida, hay una incidencia moderadamente más alta de aquellas perturbaciones que generalmente se consideran estar asociadas a daños de parto que entre los individuos de control. La diferencia tiene importancia

estadística. En otros aspectos y por lo que se refiere a otras enfermedades de incapacidad y tuberculosis, no hay diferencia entre los niños nacidos con prematuridad y los individuos de control.

3. Hay una diferencia de importancia estadística entre la altura y el peso a los 20 años de edad en las dos categorías, siendo los números más bajos para aquellos nacidos prematuramente que para los individuos de control. La incidencia de los que fueron capaces prestar su servicio militar es prácticamente la misma en ambas categorías y los nacidos con prematuridad cumplieron su deber militar por lo general tan bien como lo hicieron los individuos de control.

4. Por lo que se refiere a la adaptación social, no existen diferencias de importancia estadística o probables entre los niños nacidos prematuramente y los individuos de control. La impresión general es de que bajo ninguna condición supusieron una carga mayor para la comunidad de lo que hicieron los individuos de control y de que en la mayoría de los aspectos lo fueron tanto como aquellos.

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